The **AMORGOS** MERIS CFI (Accurate MERIS Ortho-Rectified Geo-location Operational Software) Software User Manual & Interface Control Document

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1. Purpose

The purpose of the AMORGOS tool is to generate accurate geo-location information – longitude, latitude, altitude – for each MERIS pixel,. starting from a MERIS Full Resolution product: either a Full Swath or a standard half-swath Scene product. **The quarter-swath product is not managed.**

If the input product is a Full Swath one, the current version accepts two modes. The first one preserves the organisation of the input product, namely the Level 1b product grid, it is referred to as the FSG (full swath geo-corrected) mode and generates a MER_FSG_1P product. The second one generate results re-organised in the instrument geometry, it is referred to as the FSO (full swath ortho-geolocated) mode and generates a MER_FSO_1P product.

The FSO mode first restores radiance samples and accompanying flags into Instrument Geometry, un-doing the spatial re-sampling of the Level1 processing, and computes accurate ortho-rectified geo-location using MERIS detectors individual pointing vectors, a High Resolution DEM and accurate spacecraft Orbit and Attitude files.
The FSG mode essentially skips the Instrument Geometry restoration step and computes the same geo-location information for each MERIS detector and each acquisition time but it affects these values to the corresponding MERIS L1B product pixels. It must be noted here that since the MERIS product grid is filled by a nearest neighbour method from the Instrument Acquisition grid with a slight spatial over-sampling, the same instrument sample can be found several times in the same Level 1b product (it is then identified as a DUPLICATE pixel within the Level 1b product flags). Since the additional geo-location information of the MER_FSG_1P product is linked to the source Instrument sample, it will be duplicated the same way than the radiance information.

Ortho-rectified geo-location must be understood as the computation of the intersection of a given sample line of sight with the Earth surface (as represented by the Digital Elevation Model) rather than with the reference ellipsoid as in Level 1b. However, it must be noted that image geometry is either the Instrument one (FSO mode) or the Level 1b one (FSG mode) and thus the output product is not ortho-rectified *stricto sensu*.

2. References

RD1	PO-TN-MEL-GS-003	MERIS Input/Output Data Definition Format
RD2	TBD	AMORGOS – Algorithm document
RD3	PO-RS-MDA-GS-2009	ENVISAT Product Specification
RD4	PO-IS-GMV-GS-0561	Envisat-1 Mission CFI Software -. Mission Conventions Document
RD5	PO-IS-DMS-GS-0557	Envisat-1 Mission CFI Software - PPF_LIB Software User Manual. PO-IS-DMS-GS-0557
RD6	PO-IS-DMSGS-0559	Envisat-1 Mission CFI Software - PPF_POINTING Software User Manual

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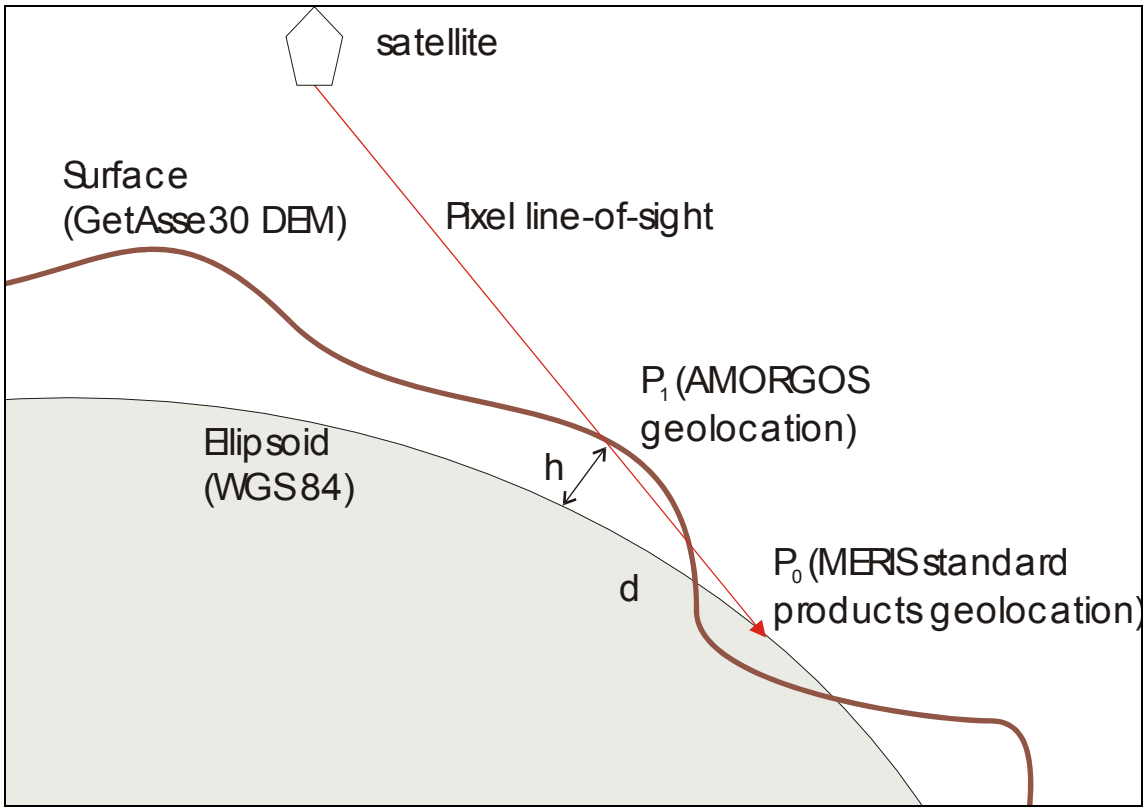
3. Overview

AMORGOS is run once for every MER_FRS_1P or MER_FR__1P file and generates the corresponding MER_FSO_1P, MER_FSG_1P or MER_FRG_1P file. Identification of the source Instrument sample (defined by a detector index and an acquisition time), and if required the re-construction of the instrument projection, is done using MER_FRS_1P internal data, the so-called MERIS detector index data set, and some additional MERIS Level 1B auxiliary data, the FR frame offsets, extracted from the appropriate MER_INS_AX file. For each MERIS sample, an ortho-geolocation algorithm computes the *first* intersection between the pixel's line of sight and the Earth surface, represented by interpolation of the GetAsse30 high resolution Digital Elevation Model (DEM) cells elevations on top of the reference ellipsoid. Line of sight is determined using its pointing vector expressed relative to the satellite, the satellite location and attitude, that are in turn determined from appropriate Orbit and Attitude files using the appropriate CFI routines. Location of the intersection is expressed as longitude, geodetic latitude and geodetic altitude.
The principle of the computation described above is illustrated on the following figure (please note that the figure does not show realistic observation conditions):



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4. Operating AMORGOS

The interface between AMORGOS and its hosting and operating facility is based on input, auxiliary and output data files. Auxiliary files are further split amongst instrument related on one hand and Digital Elevation Model files on the other hand.

The way to specify the various file paths to the software depends on the hosting platform: the Windows version includes a Graphical User Interface while the Linux version, more oriented toward mass processing in batch mode, uses a configuration file.

4.1 Windows

4.1.1 Installation

The installation kit for Windows (Microsoft Windows 2000 or higher) is on the form of an automatic installer. After download, you just have to double-click on Amorgos30_Installer.exe and follow the instructions.
You do not need to install any other software.

Note: it is highly recommended to install Amorgos as administrator! On most system configuration, if you do not have administrator privileges when installing Amorgos, the installer will fail to create the desktop shortcut (`Amorgos`) and the entry in the program launcher (program group `amorgos_interface`, application `Amorgos`). However, if you , if you install amorgos as unprivileged user but have write permissions on the installation directory, all software components will be installed correctly. To create a desktop shortcut, go to the installation directory, right-click on `amorgos_interface.exe` and select `send to` and `desktop`. To create an entry point in the program launch menu, go to the `Start Menu` directory corresponding to your own account, create there a new directory named e.g. `amorgos_interface`, and copy there a shortcut to `amorgos_interface.exe` that you can rename e.g. `Amorgos`

Amorgos installation complies with standard Windows software installation, mainly :

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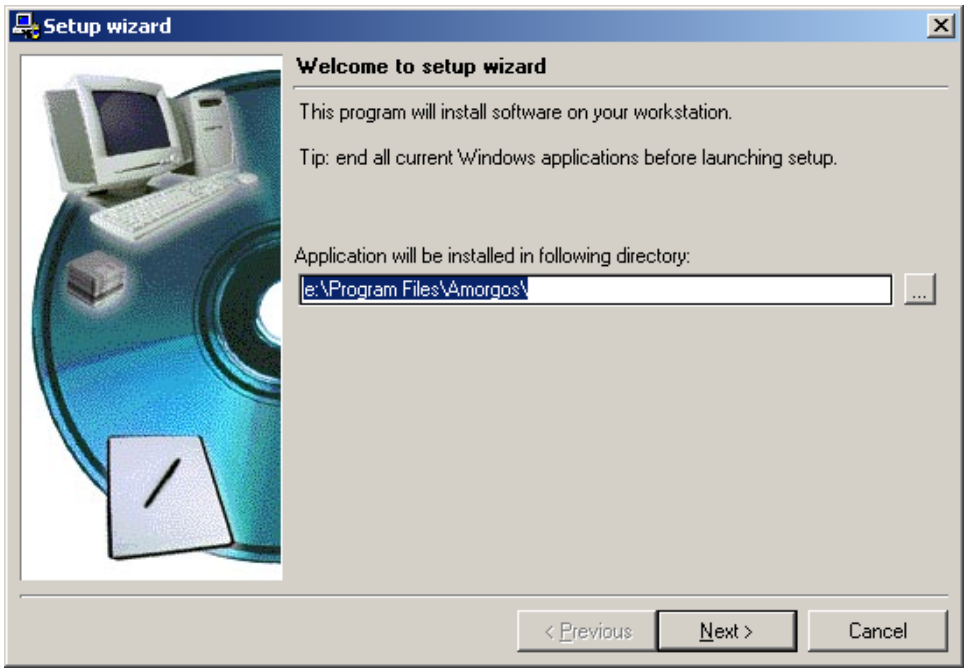
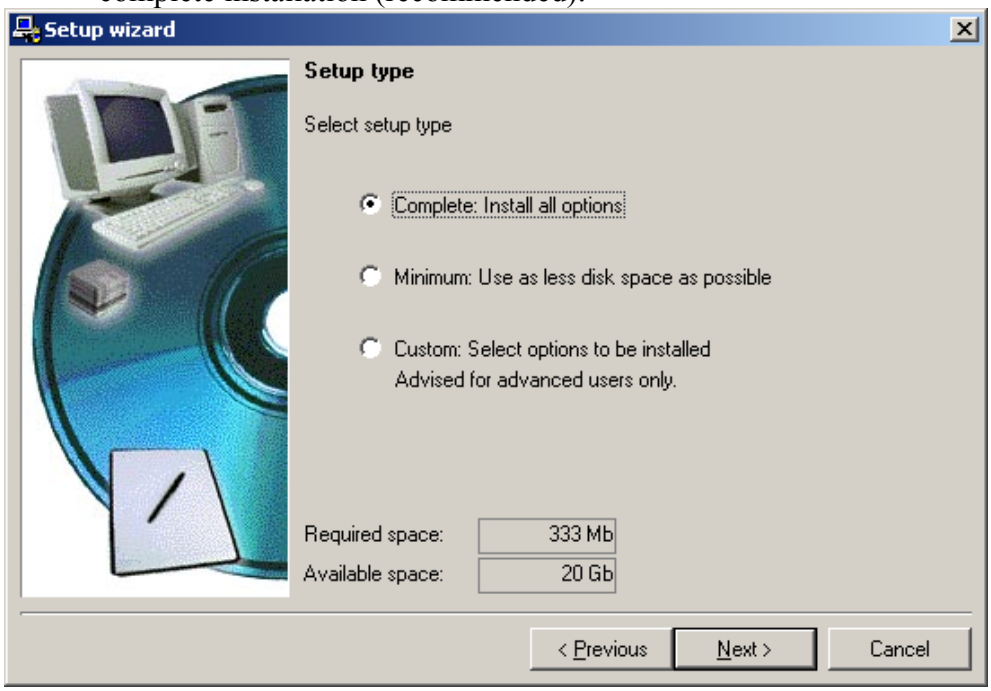
- where to install :


Setup wizard
Welcome to setup wizard
This program will install software on your workstation.
Tip: end all current Windows applications before launching setup.
Application will be installed in following directory:
e:\Program Files\Amorgos\
...
< Previous
Next >
Cancel

- which components to install :
complete installation (recommended):



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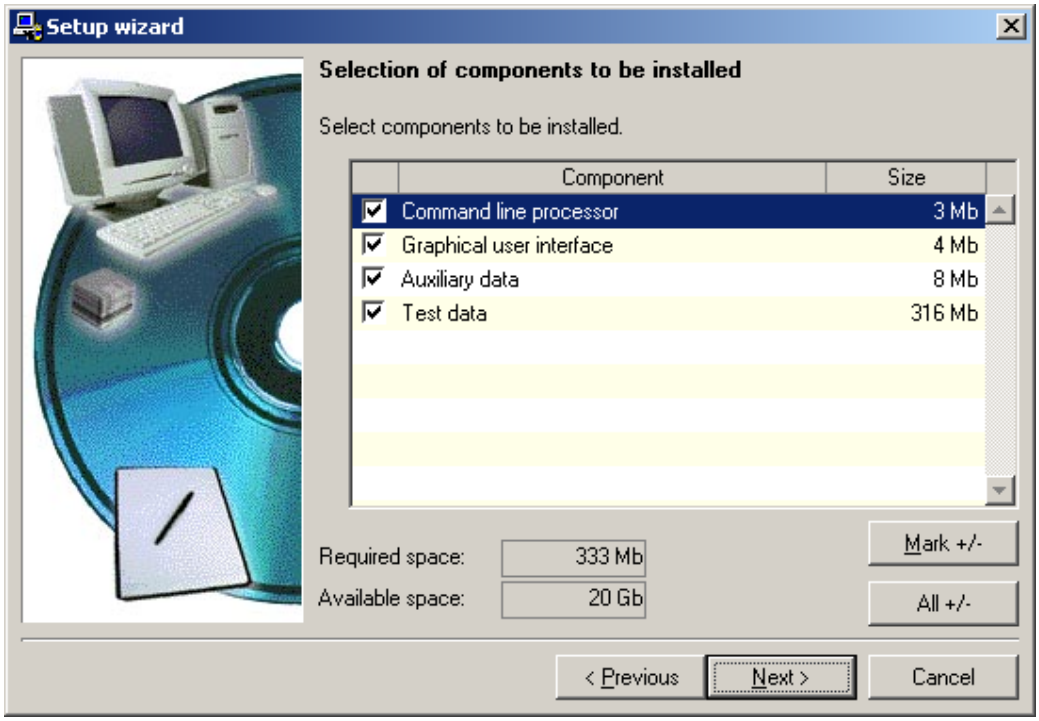
or customized one:



Note: command line processor and mandatory auxiliary data compose the minimal component set.

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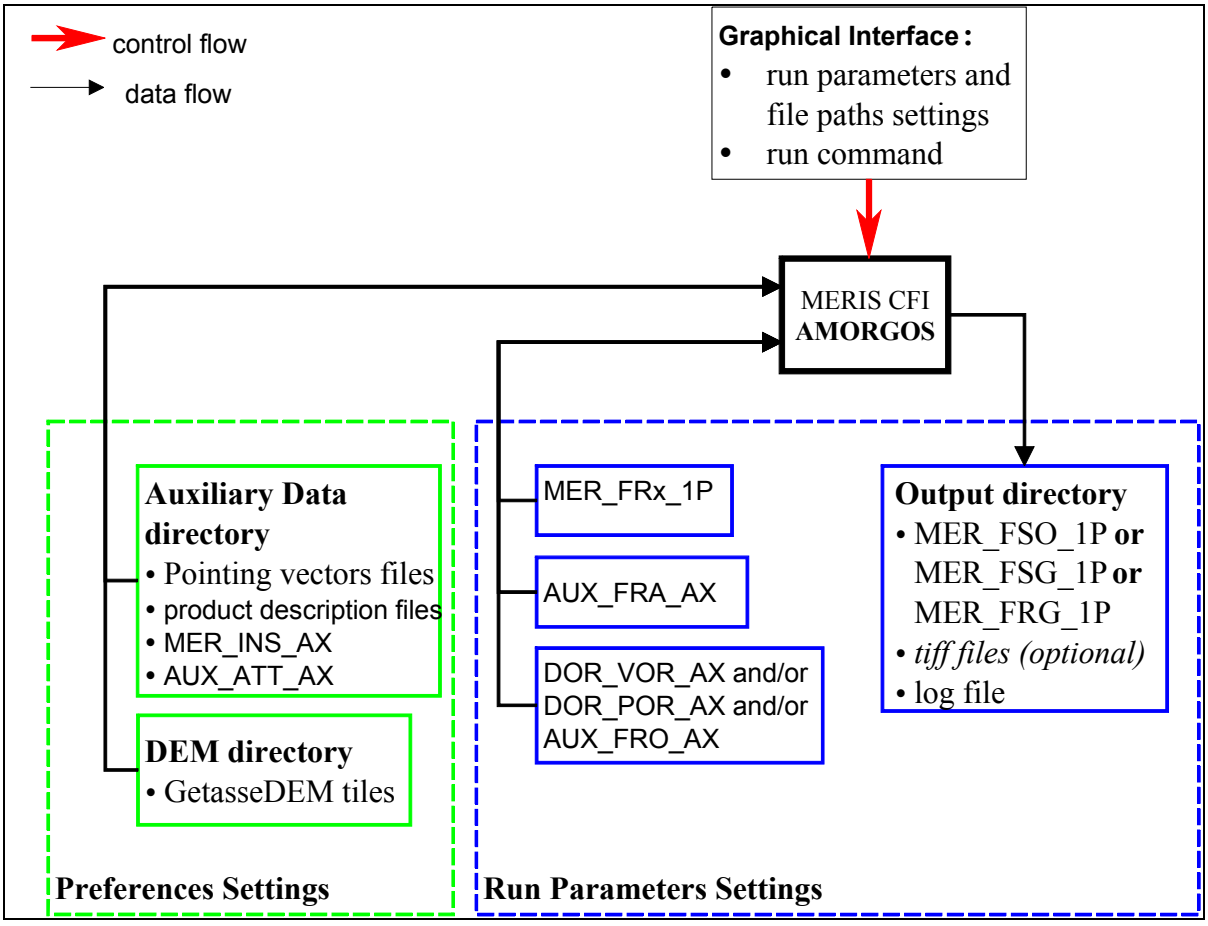
4.1.2 Running Amorgos

To launch Amorgos, you can:

- Either double-click on `amorgos_interface.exe` file in the installation directory
- Or use the shortcut icon on the desktop
- Or use the amorgos_interface\Amorgos entry point in the Launch Program menu

The set of parameters required by an Amorgos run is defined through a Graphical Interface. It is described step by step in the following sections.
Amorgos is delivered with a complete Test Data Set, in order to allow to check installation. It includes the DEM tiles necessary to run the test bun only those ones.
See section

The general data and control flow of an Amorgos run on Windows is depicted in the next figure. The figure also highlights what shall be set through the preference menu or through the Run Parameters menu.



Note: ENVISAT files names used in the above figure are generic names, it does not imply that this reflect the actual file names of a given run.

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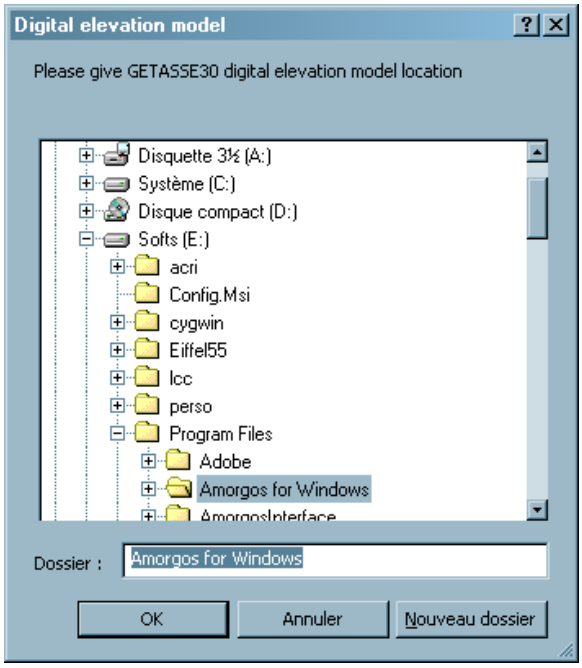
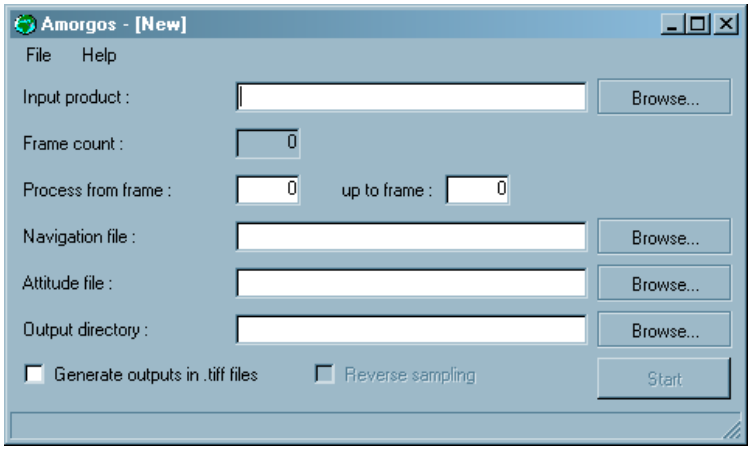
Amorgos will ask at first run for the location of the Getasse30 digital elevation model. Without this mandatory information, Amorgos will not process any data. In order to limit disk usage, the tiles set can be incomplete. If Amorgos cannot find a tile while processing, then it stops in error giving the name of the missing tile in the status file. So the user can add the needed tile, process again, and step by step complete the job.



4.1.2.1 Quick tour

This section explains how to launch the test data set in three mouse clicks.



- in the File menu, the <InstallationDirectory>\test\test.ini run file can be selected. Run parameter fields are updated, and start button becomes enabled and green.

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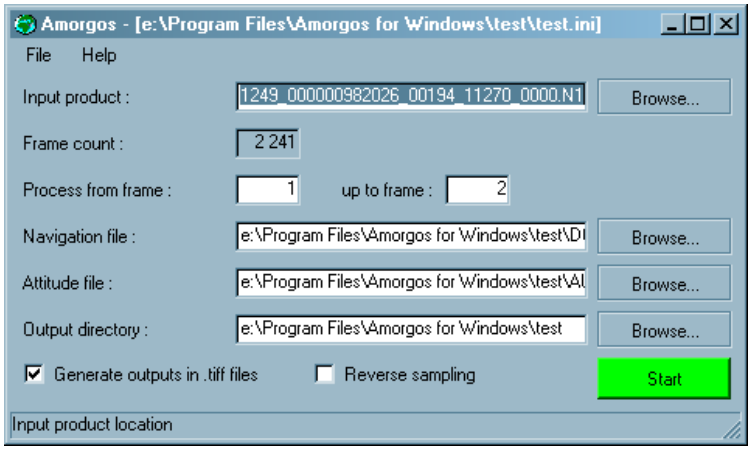
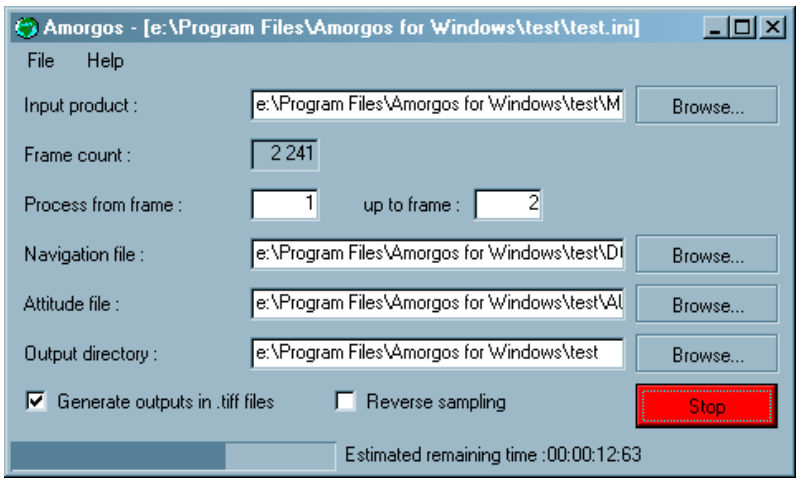


- The Start button can be pushed. it then becomes red. Progress bar and estimated remaining time appear in the message bar. After a few seconds, process completes, and status file can be visualized.



4.1.2.2 Run parameter set

An Amorgos run needs the following parameter set :

1. **the input product**: Meris full swath (MER_FRS_1P) or full resolution scene (MER_FR__1P) level 1 product to process
2. **the processing window**: frame interval to process [first frame, last frame] (see **Important Note** below)
3. **the satellite navigation file**: providing accurate ENVISAT navigation along the orbit corresponding to the input level 1 product
4. **the satellite attitude file**: providing accurate information on ENVISAT attitude (i.e. orientation in space) along the orbit corresponding to the input level 1 product. This is the only optional parameter. If not specified, processor will use the nominal attitude model. WARNING: this may result in degraded geo-location accuracy.
5. **the output directory**: where the output files will be generated
6. **TIFF format output files selection switch**: the 15 radiances and the 3 geo-location data sets (longitude, latitude and altitude) can also be generated in tiff image file format, allowing easy visualization or loading in off-the-shelf software. Note: the geo-location data are stored on 32 bits integers, which are not accepted by all visualisation softwares.

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7. **spatial re-sampling reversal switch**: if the input product is a Full Swath one, spatial re-sampling can be reversed to restore data in instrument geometry (generation of a MER_FSO_1P instead of MER_FSG_1P)

Please refer to section 4.3 for the detailed description of the input files (items 1, 3 & 4 in the above list).

Important Note: the following rules apply to the output products time limits:

1. The output product size is limited due to Operating System constraints, as a consequence, the total number of frames processed will NEVER exceed 10305 for the FSG product and 12865 for the FSO product (the latter being the specified maximum size of the input FRS product). **As a consequence, a run in FSG mode may result in a partial processing of the input file, even if complete processing was required.** Output time limits (expressed in frame units) are always reported in the status log file to allow systematic checks (see section 5.4 for message format).
2. The output product shall follow the granule rule, i.e. the total number of frames shall cover the extent of the total number of Tie Frames (Annotation records, see RD 1 for details) to ensure that any measurement frame time is within the interval defined by two consecutive annotation record times. If the [`first frame, last frame`] parameters provided do not respect these rules, `first frame` will be forced to the closest earlier Annotation frame (if required) and the actual number of processed frames will be forced to a value that completes the granule of the requested last frame (to the limit expressed by rule 1, see above).
3. Whenever the software has to modify the product time limits for any of the above reasons, an informational message will be provided in the status log file (see section 5.4 for message format).

The whole parameter set can be saved and later restored via the File/Save, Save as and Open menu items. The three last edited parameter sets can be loaded directly from the list in File menu. Edition of some parameters is always possible after a Parameter Set file has been restored.

Once all parameters have been specified and are valid, the start button is enabled, its colour then turns to light green, and data can be processed.

4.1.2.3 Preferences

Amorgos has a few configuration parameters :

1. **Digital Elevation Model location**: the path to directory that contains the Getasse30 tiles.
2. **auxiliary data location**: the path to the directory that contains auxiliary data, part of the Amorgos software package,
3. **path to command line processor binary file**.

These parameters can be edited in the File/Preference menu item. If configuration is valid, Ok button is enabled. Once pressed, parameters becomes the current configuration.
Default - installation - configuration can be later restored via "Default values" button.

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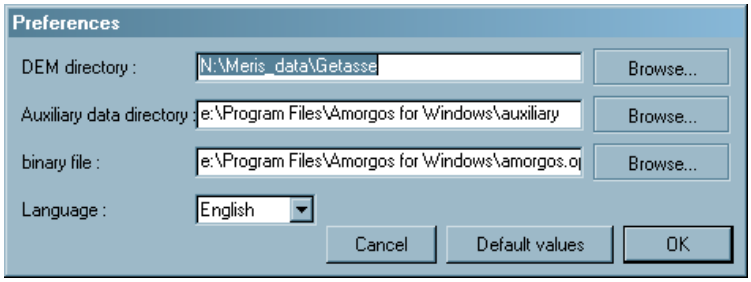

The last parameter is an interface parameter : interface language, either English or French.

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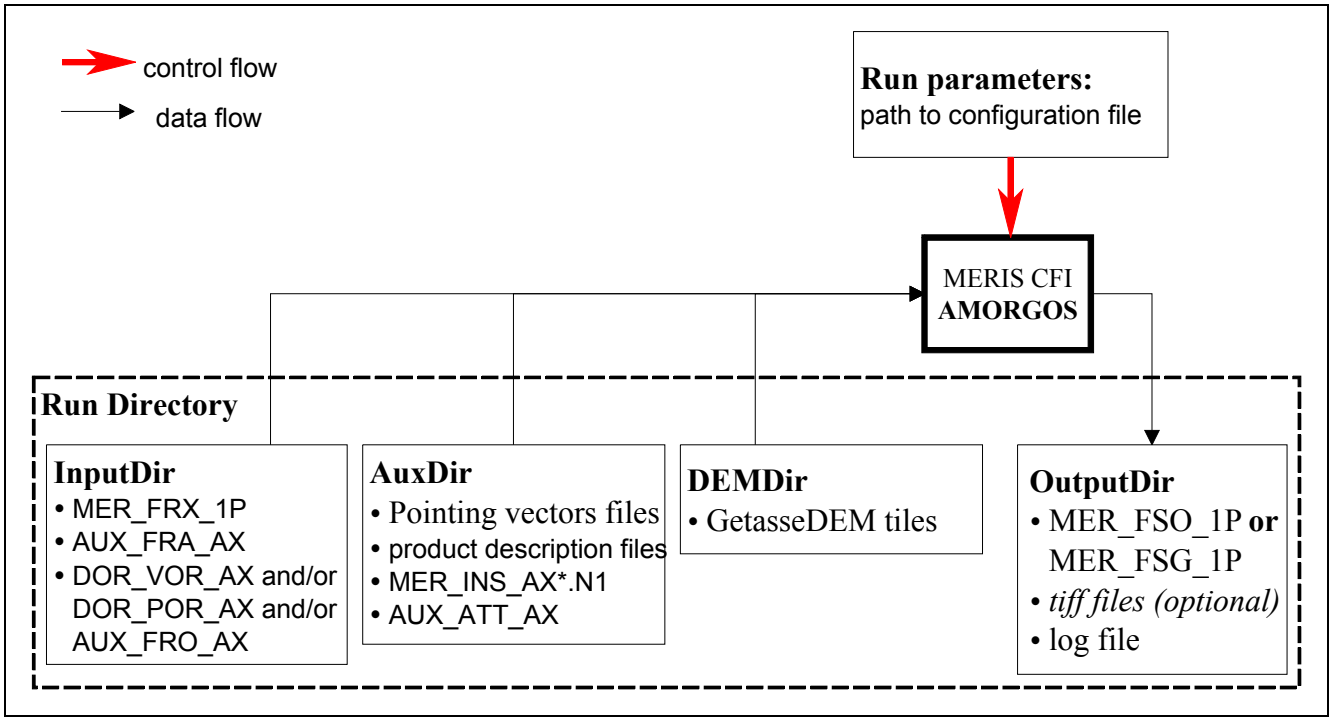
4.2 Linux

In the Linux version, Amorgos is run via a shell script, part of the delivery.
The unique entry point to the shell script is the path to a configuration file. This configuration file is used to specify actual paths to the *input*, *output, auxiliary* and *DEM* directories where AMORGOS will, respectively, expect the input files, generate the output files (including the log files) and read auxiliary files.



AMORGOS data and control flow

4.2.1 Perform the installation

CONVENTION:
In the following text, a symbol like $AMORGOS_INSTALL is used to describe your AMORGOS installation directory *from the standpoint of this document*. In the following instructions, you should replace it by its appropriate value. This convention is used with several different directories.

1. **Go into the wanted directory for restoring installation files.**

Type the following command :
cd $AMORGOS_INSTALL
Note that distribution files need about 300 MB, so make sure to have such free disk space before starting the restoration.

2. **Restore the distribution files.**

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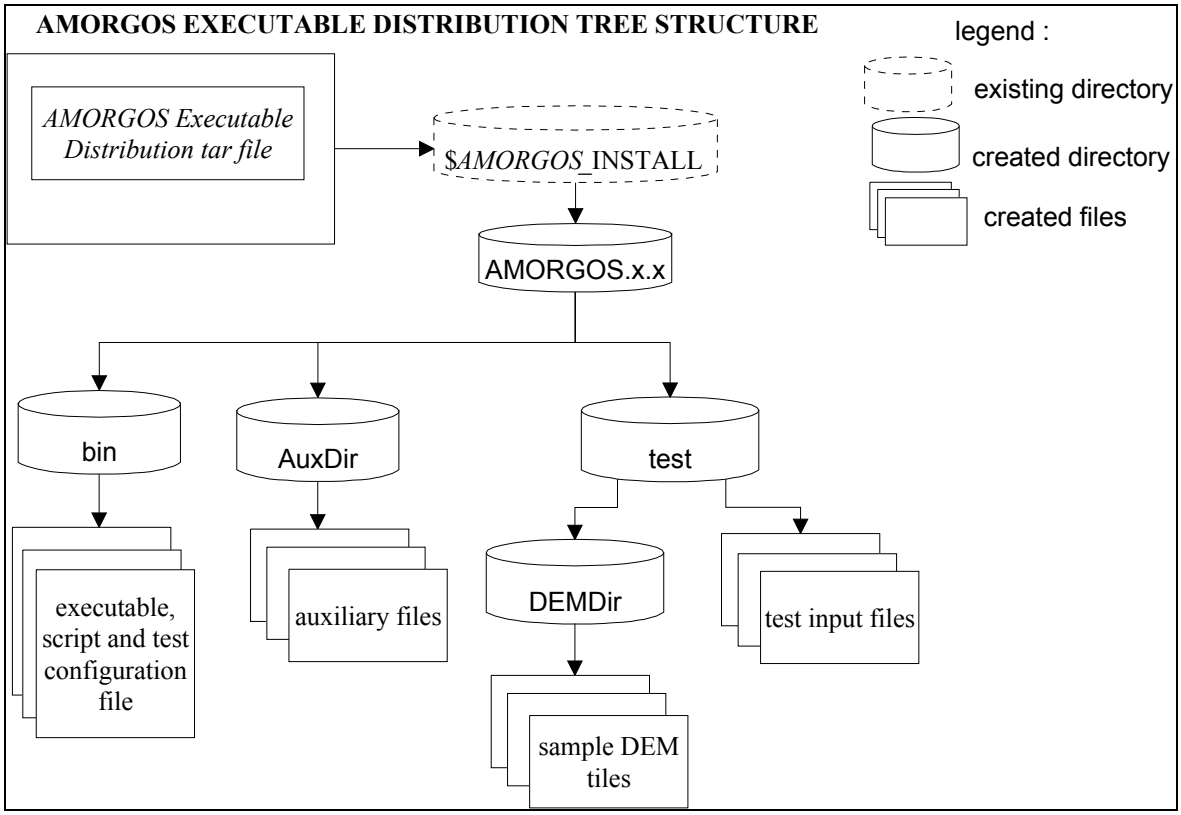
Type the following command :

`tar -xvf [<path name>/]AMORGOS.tar`

where *<path name> (optional)* is the path to the Amorgos distribution tar file.
example :
> tar -xvf /dvdrom/dvdrom0/AMORGOS.tar

This operation restores all the distribution files as outlined on the figure below:



3. Perform the test run.

The installation kit includes a full set of files to allow you to perform a test run.
For this, the simplest way is to go into the `bin` directory and type the following command:

```
./amorgos.sh ./test.ini
```

The result files will be created in the `test` directory.
You can monitor the run progress (from another command window) by the command:

`tail -f ../test/status.txt` (assuming you still are in the `bin` directory)

4.2.2 System Requirements

AMORGOS is composed of a C executable program operated through a UNIX shell script. It is intended to be run on a LINUX station with kernel 2.4.

The AMORGOS C executable needs access to the following system libraries:

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- libm.so.6 => /lib/i686/libm.so.6
- libc.so.6 => /lib/i686/libc.so.6
- /lib/ld-linux.so.2 => /lib/ld-linux.so.2

4.2.3 Command syntax

AMORGOS shall always be operated through its associated UNIX shell script `amorgos.sh`. Both the shell script and the C executable `AMORGOS` shall be located in the same directory.

Syntax:

exec_path`/amorgos.sh` *configuration_file_name*

where:

- *exec_path* is a valid UNIX path, either absolute or relative, to the directory where all the executable files can be found, e.g. `./amorgos.sh`, `/file_system/dir/amorgos.sh, ...`,
- *configuration_file_name* is a valid UNIX path name to the AMORGOS configuration file, either absolute or relative to the current directory (i.e. where the command is issued). The user issuing the command shall have read permissions for the configuration file.

4.2.4 Configuration file format and content

The configuration file is under responsibility of the user. It allows the user to specify the location of the input, auxiliary, DEM and output directories. It is an ASCII text file, formatted as a list of keywords followed by character strings enclosed in double quotes and a new line character.
Keywords must start on the first column of a line and must be followed by a "=" sign. Character strings or numerical shall follow immediately the "=" sign. There are no blank spaces. Keywords and associated values must be written on one single line. Character strings cannot exceed 128 characters. Any line starting with the `'#'` symbol is considered as a comment line and ignored; empty lines are used as separators and are ignored as well.

The directory paths fields are mandatory, as bearing essential information for the main program run. The configuration fields, CONFIG_FILE and DATE, as well as the option switches, FSO_MODE, FIRST_FRAME, FRAME_NUMBER and TIFF_SWITCH, are not mandatory: the first two have been included to ease user's configuration management but are not used internally, and the last ones are set to the default values specified below if not provided.

The requested fields are:

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Field Format	Description	Comment
CONFIG_FILE=<filepath>	Name of the configuration file	
DATE=<UTC date>	File creation date	
<empty>	Separator	
NAME_INPUT_DIR=<directory>	Identification of the input directory	**mandatory field**
NAME_AUX_DIR=<directory>	Identification of the auxiliary directory	**mandatory field**
NAME_DEM_DIR=<directory>	Identification of the auxiliary directory	**mandatory field**
NAME_OUTPUT_DIR=<directory>	Identification of the output directory	**mandatory field**
<empty>	Separator	
FSO_MODE=<0 or 1>	Processing mode switch: 0 = FSG mode (default), 1= FSO mode	
FIRST_FRAME=<n>	Index of the frame (input image line) at which processing shall start (numbering starts at 1). Defaults to 1 if not provided.	See note below.
FRAME_NUMBER=<m>	Total number of frames to process. Defaults to number of frames in the input product if not provided.	See note below.
TIFF_SWITCH=<0 or 1>	Switch enabling generation of optional output TIFF files	1=generation enabled

Where:

<filepath>:	valid Unix filename including its absolute or relative path. Up to 128 characters can be specified. If relative, path must be expressed with respect to where the amorgos.sh command is issued.
<directory>:	valid Unix directory name. Up to 64 characters can be specified.
<UTC date>:	UTC date in ENVISAT-1 external format as described in RD3.
n or m	Integer numbers greater or equal to 1, maximum values following the rules detailed below

Important Note: the following rules apply to the output products time limits:

1. The output product size is limited due to Operating System constraints, as a consequence, the total number of frames processed will NEVER exceed 10305 for the FSG product and 12865 for the FSO product (the latter being the specified maximum size of the input FRS product). **As a consequence, a run in FSG mode may result in a partial processing of the input file, even if complete processing was required.** Output time limits (expressed in frame units) are always reported in the status log file to allow systematic checks (see section 5.4 for message format).
2. The output product shall follow the granule rule, i.e. the total number of frames shall cover the extent of the total number of Tie Frames (Annotation records, see RD 1 for details) to ensure that any measurement frame time is within the interval defined by two consecutive annotation record times. If the FIRST_FRAME and / or the FRAME_NUMBER options are provided and do not respect these rules, FIRST_FRAME will be forced to the closest earlier Annotation frame (if required) and the actual number of processed frames will be forced to a value that completes the that completes the granule of the requested last frame (to the limit expressed by rule 1, see above).
3. Whenever the software has to modify the product time limits for any of the above reasons, an informational message will be provided in the status log file (see section 5.4 for message format).

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Examples:

```
CONFIG_FILE="/ocean/data/AMORGOS/test_Averaging/AMORGOS.config"
DATE="12-DEC-2005 18:16:00.000000"

NAME_INPUT_DIR="/Disk1/data/AMORGOS/test_Adriatic/input"
NAME_AUX_DIR="/Disk1/data/AMORGOS/Auxiliary"
NAME_DEM_DIR="/Disk2/Ancillary/GETASSE"
NAME_OUTPUT_DIR="/Disk1/data/AMORGOS/test_Adriatic/output"

TIFF_SWITH=0

CONFIG_FILE="/Disk1/data/AMORGOS/test_Adriatic/AMORGOS.config"
DATE="12-DEC-2005 18:16:00.000000"

NAME_INPUT_DIR="/Disk1/data/AMORGOS/test_Adriatic/input"
NAME_AUX_DIR="/Disk1/data/AMORGOS/Auxiliary"
NAME_DEM_DIR="/Disk2/Ancillary/GETASSE"
NAME_OUTPUT_DIR="/Disk1/data/AMORGOS/test_Adriatic/output"

FSO_MODE=0
FIRST_FRAME=10305
FRAME_NUMBER=2561
TIFF_SWITCH=1
```

4.2.5 Run Configuration

Once the configuration is properly set to define all the run parameters, the following set of files must be available to the software:

In the Input Directory:
All the files mentioned in section 0, respecting naming conventions specified for Linux by either physical copy or link.

In the Auxiliary Directory:
All the files mentioned in section 4.3.3, respecting naming conventions specified for Linux by either physical copy or link.

In the DEM Directory:
All the Getasse30 tiles necessary to cover the area delineated by the MERIS Level 1b product to be processed. File names must be the original Getasse30 distribution ones.

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4.3 Detailed Interface

4.3.1 Overview

Distinction is made between input files, specific to a given AMORGOS run, and auxiliary ones, common to all runs, or at least unfrequently modified. In addition, the DEM files are expected in a different directory, because they are assumed user provided and their total size makes them somewhat difficult to handle.

AMORGOS expects the user to define the path to each of the input files - listed in section 4.3.2 below. Under Linux, they are all gathered in *the input directory*, the path of which is specified in the configuration file ; under Windows, they are individually selected interactively.

AMORGOS will create all the output files - listed in section 4.3.3 below - in the *output directory*, the path of which is specified in the configuration file (Linux) or interactively (Windows). AMORGOS also needs to access auxiliary files, delivered with the software, in the *auxiliary directory*, the path of which is specified in the configuration file (Linux) or interactively (Windows), and, finally, access to the GETASSE Digital Elevation Model tiles, assumed to be located in a single directory, the *DEM directory*, the path of which is also specified in the configuration file (Linux) or interactively (Windows).

AMORGOS shall have write and read rights for the *output directory* and its content. Read right is sufficient for all other directories and files.

It should be noted that the *input*, *output, auxiliary* and *DEM directories* can be identical providing that the above rules are satisfied.

4.3.1.1 Where to get the ESA provided files

The Amorgos distribution provides only the Amorgos auxiliary files and a test data set. To proceed to other runs you may need:

Another MERIS full resolution product. If you are interested by Amorgos, we assume that you know how to order MERIS data products, however more details can be found at:
http://earth.esa.int/pcs/envisat/meris/documentation/Access_to_MERIS_data.pdf

Corresponding Orbit and Attitude files. They can be obtained from ESA upon request to EOHelp@esa.int.

Complementary GETASSE30 files. The whole distribution can downloaded from:
http://earth.esa.int/services/amorgos/download/getasse/ (288 files of 12 :Mb each, or 3.48 Gb as a whole). Optionally, the full distribution can be obtained on DVD upon request to EOHelp@esa.int.

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4.3.2 Input files

File Name	File description	Descr. §	Origin
unconstrained	*Configuration file (Linux only)*	*4.2.3*	*User defined*
MER_FRX_1P (Linux), unconstrained (Windows)	MERIS full resolution full swath or full resolution scene Level 1B product	See RD1	ESA provided
DOR_VOR_AX and/or, DOR_POR_AX and/or, AUX_FRO_AX (Linux) unconstrained (Windows)	ENVISAT Orbit files. Note: the software selects the 'best quality' file among the actually available files. Only one of them is mandatory.	See RD3	ESA provided
AUX_FRA_AX(Linux), unconstrained (Windows)	Restituted Attitude file	See RD3	ESA provided

Note: (Linux) generic name of the input Level 1b product has been set to MER_FRX_1P to accommodate for the ability of Amorgos to process MER_FR__1P and MER_FRS_1P products.

WARNING: Input files are user provided and under user's responsibility. In particular, the user must ensure, to properly process a given MER_FRS_1P or MER_FR__1P:

1. Amorgos do not process all kinds of MER_FR__1P products. They exist in two sizes: the scene product, also referred to as half-swath, and the imagette, or quarter-swath, product. The former has a spatial extent of 2241 by 2241 pixels and the latter 1121 by 1121. **AMORGOS can only process half-swath scenes MER_FR__1P.**
2. to provide the appropriate AUX_FRA_AX file, that is a file who's content must cover the time span of the MERIS FR product to be processed plus TBD seconds before and TBD seconds after.
3. to provide at least one appropriate orbit file, among DOR_VOR_AX DOR_POR_AX and AUX_FRO_AX, with a content that must cover the time span of the MER_FRS_1P product to be processed plus 4 minutes before and 4 minutes after.
4. that all files submitted to processing are properly named according to the File Name column of the above Table (Linux).

4.3.3 Auxiliary files

File Name	File description	Descr. §	Origin
MER_INS_AX*.N1	Set of MERIS Instrument Data Products (Amorgos will automatically select the one mentioned in the MER_FRX_1P metadata)	See RD1	ACRI-ST provided
Pointing_at_Pixels_FR_SaCS.m?	Pointing vector files. The ? sign stands for any number within 1, 5 and identifies the corresponding MERIS camera module.	5.1	ACRI-ST provided
AUX_ATT_AX	Envisat Predicted Attitude file Note: if the appropriate AUX_FRA_AX is provided, this file will not be used.	See RD3	ACRI-ST provided
index_?.txa, database.db	MERIS products description files. The ? sign stands for a one-digit alpha-numeric	N/A	ACRI-ST provided

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	character identifying a given product file.		

All the files described above are provided with the Amorgos software.
It is kindly suggested to the user to leave them unchanged.

4.3.4 GetAsse30 DEM files

File Name	File description	Descr. §	Origin
xxVyyyH.GETASSE30	Set of Digital Elevation Model tiles, each one covering an area of 15 degrees of longitude by 15 degrees of latitude (Amorgos will automatically determine which ones are necessary for a given processing and access only those). xxVyyyH corresponds to the latitude and longitude of the South-West corner of the covered area: xx (resp. yyy) is the latitude (resp. longitude) value, by steps of 15 degrees, V (resp. H) identifies the North or South (resp. West or East) hemisphere. xx ranges 0 to 65 if V=N, 15 to 90 if V=S yyy 15 to 180 if H=W, 0 to 165 if H=E	N/A	ESA provided

4.3.5 Output files

File Name	File description	Descr. §
MER_FSO_1P, MER_FSG_1P or MER_FRG_1P	Output file in PDS format	5.2 to 5.4
status.txt, error.txt	Status and error log files	5.5
radiance.?.tiff	Optional TIFF format output radiance files. ? stands for the spectral band index, in [1,15]	5.6
flags.tiff	Optional TIFF format flags file	5.6
logitude.tiff, latitude.tiff, altitude.tiff	Optional TIFF format geolocation data files	5.6

Important Note: AMORGOS will always generate the MER_FSO_1P (resp. MER_FSG_1P, MER_FRG_1P) output file under its generic name "MER_FSO_1P" (resp. MER_FSG_1P, MER_FRG_1P) , however, the PRODUCT field of its MPH is appropriately filled. It is the responsibility of the user to rename the file accordingly. This renaming can be done easily by a simple Unix command, e.g. in MER_FSG_1P case:

```
mv MER_FSG_1P `head -1 MER_FSG_1P | cut -d'=' -f2 | sed s/\"//g`
```

Execution of AMORGOS generates a status log file, and in some cases, an error log file, in the output directory, named `status.txt` and `errors.txt` respectively. The status log file is intended to be the recipient of all the messages generated during an AMORGOS run, either

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informational or reporting an error or exceptional event. The error log file is intended to be the recipient of all the messages reporting an exception or an unexpected event during an AMORGOS run. It allows an immediate verification of the run status.

There are two levels of errors occurring in AMORGOS: warnings and fatal errors. Execution continues normally after a warning is sent but a fatal error causes AMORGOS to stop immediately after it is raised.

4.3.6 Returned value

The AMORGOS associated shell script `amorgos.sh` returns 0 if successful, and a value different from 0 if an error occurred.

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5. Files Format and Content

5.1 MERIS Pixels Pointing Vector Files

name : Pointing_at_Pixels_FR_SaCS.m%
content : Pointing vectors projection on X and Y axis of SaCS for each FR column
data origin : MERIS Calibration CFI
type : all ASCII file
format :

header :

Line description	C format	arguments
keyword :	#FD="%s"	"Interpolated pointing directional cosines Ux and Uy in SaCS, FR pixels"
file creation date	#CD="%s"	date of file creation/update in UTC
identifiers :	#ID=%d, m=%d	1, module index
number of dimensions :	#ND=%d	1
number of data per line	#NC=%d	3
dimension1 :	#D1=%d	number of spatial positions in data (740)
band set description	#BS=%d, %d-%d, ..., %d-%d	number of bands and for each, first CCD row index and width in CCD rows (... stands for all the missing format descriptors ", %d-%d" needed to match the actual number of bands)
format mnemonic :	#FM="%s"	"k, Ux, Uy"
read format	#RF="%s"	"%d %le %le"

data : each line is composed of a set of three values

symbol :	k	Ux	Uy
meaning :	CCD column index	X projection	Y projection
format	%d	%.15e	%.15e
unit	dl	dl	dl

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5.2 MER_FSO_1P

5.2.1 - Summary

The Level 1b Full Swath Full Resolution Ortho-geolocated Product, hereafter referred to as Level 1b FSO, is summarised below:

Name	Level 1b full resolution
Identifier	MER_FSO_1P
Product Level	1b
Description	Radiance measurements at top of atmosphere for the 15 MERIS bands, in instrument projection, calibrated, radiometrically corrected, geo-located with orthorectification at pixel level, annotated with PCD, calibration data, classification flags, environment parameters
Coverage	Regional
Packaging	Segment (see definition in [RD1] §2.4, here limited to a maximum duration of 9mn 26s or 12865 lines)
Unit	10^{-3} $W.m^{-2}.sr^{-1}.nm^{-1}$
Range	0..26 to 0..270 (band dependent)
Sampling	**spatial :** 260 m across track at nadir and 290 m along track. **spectral :** MERIS bands (see [RD1] Table 3.2.1)
Resolution	**radiometric :** NEDL (see [R-5] of [RD1]) **spatial :** MTF > 0.3 at Nyquist freq. ([R-5] of [RD1]) **spectral :** ≤ 2.5 nm ([R-5] of [RD1])
Accuracy	**radiometric :** ≤ 2% in 400-900 nm range ([R-5] of [RD1]) **absolute geometric :** 2000m (spec. in [R-5] of [RD1]) **relative geometric :** 1000m (spec. in [R-5] of [RD1])
Geo-location requirements	Each instrument pixel is geo-located with orthorectification (i.e. accounting for the Earth surface elevation as provided by a Digital Elevation Model).
Format	• 16 bits/sample • 3700 samples/record • 19 records/line • up to 12865 lines/MDS • 1 GADS, 2 ADS & 19 MDS (15 for TOA LU, 1 for flags, 3 for longitudes, latitudes and altitudes)
Annotated data	see below
Frequency	Variable (upon Level 0 data availability and processing requests)
Size	1818 Mbytes per product (max)

Table 4.3.2.1 - Level 1b Full Swath Ortho-geolocated Product - Summary

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5.2.2 - Organization

The high-level breakdown of the Level 1-FSO product is described below:

Description	Size
Level 1b FSO - MPH	1247
Level 1b FSO - SPH	10782
Level 1b FSO - Summary Quality ADS	858
Level 1b FSO - GADS Scaling Factors	292
Level 1b FSO - ADS Tie Points Location & Aux. Data	719726
Level 1b FSO - MDS(1) TOA Radiance	95368245
Level 1b FSO - MDS(2) TOA Radiance	95368245
Level 1b FSO - MDS(3) TOA Radiance	95368245
Level 1b FSO - MDS(4) TOA Radiance	95368245
Level 1b FSO - MDS(5) TOA Radiance	95368245
Level 1b FSO - MDS(6) TOA Radiance	95368245
Level 1b FSO - MDS(7) TOA Radiance	95368245
Level 1b FSO - MDS(8) TOA Radiance	95368245
Level 1b FSO - MDS(9) TOA Radiance	95368245
Level 1b FSO - MDS(10) TOA Radiance	95368245
Level 1b FSO - MDS(11) TOA Radiance	95368245
Level 1b FSO - MDS(12) TOA Radiance	95368245
Level 1b FSO - MDS(13) TOA Radiance	95368245
Level 1b FSO - MDS(14) TOA Radiance	95368245
Level 1b FSO - MDS(15) TOA Radiance	95368245
Level 1b FSO - MDS(16) Flags	47767745
Level 1b FSO - MDS(17) Longitude	190569245
Level 1b FSO - MDS(16) Latitude	190569245
Level 1b FSO - MDS(16) Altitude	95368245
Product Size	!Erreur de syntaxe,)

Table 4.3.2.2 - Level 1b Full Swath Ortho-geolocated Product - High-level breakdown

5.2.3 - Main Product Header

The format and the content of the Main Product Header shall be as specified in [RD3].

5.2.4 - Specific Product Header

The Specific Product Header format shall be as specified in [RD3].

The Data Set Descriptor format shall be as specified in [RD3].

The Level 1b Full Swath Ortho-geolocated Product Specific Product Header will be in ASCII format and its content shall be as follows:

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N	Byte #	Description	Unit	T	D	# Bytes
1	0	**SPH_DESCRIPTOR=**	keyword	uc	15	15
		quotation mark (“)	-	uc	1	1
		SPH Descriptor ASCII string describing the product.	-	uc	28	28
		quotation mark (“)	-	uc	1	1
		newline character	terminator	uc	1	1
2	46	**STRIPLINE_CONTINUITY_INDICATOR=**	keyword	uc	31	31
		Value: 0= No stripline continuity, the product is a complete segment Other: Stripline Counter	-	Ac	1	4
		newline character	terminator	uc	1	1
3	82	**SLICE_POSITION=**	keyword	uc	15	15
		Value: +001 to NUM_SLICES Default value if no stripline continuity = +001	-	Ac	1	4
		newline character	terminator	uc	1	1
4	102	**NUM_SLICES=**	keyword	uc	11	11
		Number of slices in this stripline Default value if no continuity = +001	-	Ac	1	4
		newline character	terminator	uc	1	1
		Product Time Information				
5	118	**FIRST_LINE_TIME=**	keyword	uc	16	16
		quotation mark (“)	-	uc	1	1
		Azimuth time first line of product. UTC Time of first range line in the MDS of this product. UTC time format contained within quotation marks.	UTC	uc	27	27
		quotation mark (“)	-	uc	1	1
		newline character	terminator	uc	1	1
6	164	**LAST_LINE_TIME=**	keyword	uc	15	15
		quotation mark (“)	-	uc	1	1
		Azimuth time last line of product Time of last range line in the MDS of this product. UTC time format contained within quotation marks.	UTC	uc	27	27
		quotation mark (“)	-	uc	1	1
		newline character	terminator	uc	1	1
		Product Positioning Information				
7	209	**FIRST_FIRST_LAT=**	keyword	uc	16	16
		Geodetic Latitude of the first sample of the first line A negative value denotes south latitude, a positive value denotes North latitude	10 -6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1

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8	247	**FIRST_FIRST_LONG=**	keyword	uc	17	17
		East geodetic longitude of the first sample of the first line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
9	286	**FIRST_MID_LAT=**	keyword	uc	14	14
		Geodetic Latitude of the middle sample of the first line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
10	322	**FIRST_MID_LONG=**	keyword	uc	15	15
		East geodetic longitude of the middle sample of the first line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
11	359	**FIRST_LAST_LAT=**	keyword	uc	15	15
		Geodetic Latitude of the last sample of the first line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
12	396	**FIRST_LAST_LONG=**	keyword	uc	16	16
		East geodetic longitude of the last sample of the first line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
13	434	**LAST_FIRST_LAT=**	keyword	uc	15	15
		Geodetic Latitude of the first sample of the last line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
14	471	**LAST_FIRST_LONG=**	keyword	uc	16	16
		East geodetic longitude of the first sample of the last line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
15	509	**LAST_MID_LAT=**	keyword	uc	13	13
		Geodetic Latitude of the middle sample of the last line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1

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16	544	**LAST_MID_LONG=**	keyword	uc	14	14
		East geodetic longitude of the middle sample of the last line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
17	580	**LAST_LAST_LAT=**	keyword	uc	14	14
		Geodetic Latitude of the last sample of the last line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
18	616	**LAST_LAST_LONG=**	keyword	uc	15	15
		East geodetic longitude of the last sample of the last line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
19	653	**Spare (blank characters)**	-	uc	47	47
		newline character	terminator	uc	1	1
		Product Quality Information				
20	701	**TRANS_ERR_FLAG=**	keyword	uc	15	15
		Set to 1 if number of transmission errors exceeds threshold. Set to 0 otherwise.	-	uc	1	1
		newline character	terminator	uc	1	1
21	718	**FORMAT_ERR_FLAG=**	keyword	uc	16	16
		Set to 1 if number of format errors exceeds threshold. Set to 0 otherwise.	-	uc	1	1
		newline character	terminator	uc	1	1
22	736	**DATABASE_FLAG=**	keyword	uc	14	14
		Flag set to 1 if the processing parameters data base contents does not match the packet header contents.	-	uc	1	1
		newline character	terminator	uc	1	1
23	752	**COARSE_ERR_FLAG=**	keyword	uc	16	16
		Flag indicating coarse offsets are above threshold	-	uc	1	1
		newline character	terminator	uc	1	1
24	770	**ECMWF_TYPE=**	keyword	uc	11	11
		0 = forecast ECMWF data was used 1 = analysis ECMWF data was used	-	uc	1	1
		newline character	terminator	uc	1	1
25	783	**NUM_TRANS_ERR=**	keyword	uc	14	14
		Number of transmission errors in the product	-	A1	1	11
		newline character	terminator	uc	1	1
26	809	**NUM_FORMAT_ERR=**	keyword	uc	15	15
		Number of format errors in the product	-	A1	1	11
		newline character	terminator	uc	1	1
27	836	**TRANS_ERR_THRESH=**	keyword	uc	17	17
		Threshold for setting TRANS_ERR_FLAG	%	Afl	1	15
		<%>	units	uc	3	3
		newline character	terminator	uc	1	1

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28	872	**FORMAT_ERR_THRESH=**	keyword	uc	18	18
		Threshold for setting FORMAT_ERR_FLAG	%	Afl	1	15
		<%>	units	uc	3	3
		newline character	terminator	uc	1	1
29	909	**Spare (blank characters)**	-	uc	77	77
		newline character	terminator	uc	1	1
		Additional Product Information				
30	987	**NUM_BANDS=**	keyword	uc	10	10
		Number of bands in the product	-	Ac	1	4
		newline character	terminator	uc	1	1
31	1002	**BAND_WAVELEN=**	keyword	uc	13	13
		List of up to 15 band central wavelengths of the bands contained in this product. Unused values are set to zero.	10-3 nm	Al	15	165
		<10-5nm>	units	uc	8	8
		newline character	terminator	uc	1	1
32	1189	**BANDWIDTH=**	keyword	uc	10	10
		List of up to 15 bandwidths for the bands in the product. The order of the list must match the order of the central wavelengths entries in the previous field. Unused values are set to zero. Each entry is of the form Al. e.g., if only 13 bands were included in the product: +10000+10000+10000+10000+10000+10000+10000+07500+02500+05000+12500+10000+12500+00000+00000	10-3 nm	As	15	90
		<10-3nm>	units	uc	8	8
		newline character	terminator	uc	1	1
33	1198	**INST_FOV=**	keyword	uc	9	9
		Instantaneous Field of View	10-6 deg	Al	1	11
		<10-6deg>	units	uc	9	9
		newline character	terminator	uc	1	1
34	1328	**PROC_MODE=**	keyword	uc	10	10
		Processor mode of operation 1 = Raw 0 = Full Processing	flag	uc	1	1
		newline character	terminator	uc	1	1
35	1340	**OFFSET_COMP=**	keyword	uc	12	12
		Offset Compensation 1=ON 0=OFF	flag	uc	1	1
		newline character	terminator	uc	1	1
36	1354	**LINE_TIME_INTERVAL=**	keyword	uc	19	19
		Line spacing in time	(10-6) sec	Al	1	11
		<10-6s>	units	uc	7	7
		newline character	terminator	uc	1	1
37	1392	**LINE_LENGTH=**	keyword	uc	12	12
		Number of samples per output line	samples	As	1	6
		<samples>	units	uc	9	9
		newline character	terminator	uc	1	1
38	1420	**LINES_PER_TIE_PT=**	keyword	uc	17	17
		Number of lines between along track tie points	lines	Ac	1	4
		newline character	terminator	uc	1	1

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39	1442	**SAMPLES_PER_TIE_PT=**	keyword	uc	19	19
		Number of samples between across track tie points	samples	Ac	1	4
		newline character	terminator	uc	1	1
40	1466	**COLUMN_SPACING=**	keyword	uc	15	15
		On ground spacing between columns	m	Afl	1	15
		<m>	units	uc	3	3
		newline character	terminator	uc	1	1
41	1500	**Spare (blank characters)**	-	uc	41	41
		newline character	terminator	uc	1	1
		DSDs for included Data Sets				
42	1542	**DSD-A of Level 1b Summary Quality ADS (SQADS)**	-	dsd	1	280
43	1822	**DSD-G of Level 1b Scaling Factors and General info GADS**	-	dsd	1	280
44	2102	**DSD-A of Level 1b Tie Points Loc. & Aux. Data ADS**	-	dsd	1	280
45	2382	**DSD-M(1-15) of Level 1b TOA Radiances MDSs**	-	dsd	15	4200
46	6582	**DSD-M(16) of Level 1b Flags & Detector Index**	-	dsd	1	280
46	6582	**DSD-M(17) of Level 1b Corrected Longitude**	-	dsd	1	280
46	6582	**DSD-M(18) of Level 1b Corrected Latitude**	-	dsd	1	280
46	6582	**DSD-M(19) of Level 1b Altitude**	-	dsd	1	280
		DSDs for referenced Data Sets				
47	6862	**DSD-R Level 0 data file**	-	dsd	1	280
48	7142	**DSD-R Instrument auxiliary data file**	-	dsd	1	280
49	7422	**DSD-R Proc. L1b control parameters data file**	-	dsd	1	280
50	7702	**DSD-R Radiometric calibration data file**	-	dsd	1	280
51	7982	**DSD-R Digital Elevation Model data file**	-	dsd	1	280
52	8262	**DSD-R Digital Roughness Model data file**	-	dsd	1	280
53	8542	**DSD-R Coast-line/Land/Ocean file**	-	dsd	1	280
54	8822	**DSD -R for ECMWF files used**	-	dsd	1	280
55	9102	**DSD- R for Orbit State Vectors Used**	-	dsd	1	280
56	9382	**DSD-R Platform Attitude data file (CFI software)**	-	dsd	1	280
57	9662	**DSD-R High Resolution Digital Elevation Model**	-	dsd	1	280
		size (in bytes)				**10782**

Table 5.3.1.4 - Level 1b Full Swath Ortho-geolocated Product - SPH

All Data Set Descriptors (DSD) shall follow the format and have the content described in [RD3].

Note: to keep the maximum commonality between the various Level 1b products, three fields have been kept in the SPH of the FSO products but are NOT applicable to it because the FSO product do not comply with the MERIS Product Grid defined in section 4.2 of [RD1]. Those fields are fields 38, 39 and 40 of the above table, related to the Product Grid definition, and shall be ignored. According to [RD3], since not relevant, their values are set to 0.

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5.2.5 - Annotation Data Set - Summary Quality

The Annotation Data Set format shall be as specified in [RD3].

This ADS contains only data useful for the evaluation of the quality of the product. It shall have one ADS Record for every new group of 8 tie frames (a new record has to be generated when starting the 9th tie frame, the last Summary Quality record of the product may be relevant for less than 8 tie frames), therefore it will hold (up to) 26 Records in the Full swath Ortho-geolocated product.
In the MER_FSO_1P generation process, these data are not re-evaluated but copied from the input product. In the case of a partial processing, even if the first MDS record does belongs to the first ADS Summary Quality record, it may not correspond to its start limit. In other words synchronisation between ADS Summary Quality and MDS may be lost and corresponding information is only partially relevant.

The size of the ADS has been summarised below:

ADSR no	Description	Size (bytes)
0	ADSR associated with line # 1 - 512 FR pixels	33
1	ADSR associated with line # 513 - 1024 FR pixels	33
...	...	...
25	ADSR associated with line # 12801 - 12865 FR pixels	33
	Total (in bytes)	**858**

Table 4.3.2.5 - Level 1b Full Swath Ortho-geolocated Product - Summary Quality ADS

The format and content of the Summary Quality ADSR is identical to the Level 1b Reduced Resolution Product Summary Quality ADSR described in § 5.3.1.5 of [RD1].

5.2.6 - Global Annotation Data Set - Scaling Factors

The Global Annotation Data Set format shall be as specified in [RD3].

The content of the GADS- Scaling Factors of the Level 1b Full Swath Ortho-geolocated Product is identical to the Level 1b Reduced Resolution Product GADS- Scaling Factors described in § 5.3.1.6 of [RD1] .

5.2.7 - Annotation Data Set - Tie Points Location & corresp. Aux. Data

The Annotation Data Set format shall be as specified in [RD3].

The tie point separation of the Full Swath Ortho-geolocated product will be identical to that of the reduced resolution spacing on ground (kilometres). The Full Swath Ortho-geolocated being in instrument projection, i.e. not resampled to the MERIS Product Grid defined in section 4.2 of [RD1], there is no direct correspondence between pixel grid and Tie Points grid. However, the tie points along-track sampling, or time sampling, still correspond to 64 instrument time sampling steps. The number of tie points at a give time (across-track sampling) is kept to 71 so that they cover the full MERIS swath width.

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The FSO product grid consisting of up to 12865 (AL) records, there are up to 202 tie Annotation Data Sets Records for the MER_FSO_1P Product.
Each ADS is made of ADS Records (one ADSR for each line of the tie points grid, see RD1 section 4.2), the size of the ADS has been summarised below:

ADSR no	Description	Size
0	ADSR # 1	3563
1	ADSR # 2	3563
...	...	...
201	ADSR # 202	3563
	Total (in bytes)	**719726**

Table 4.3.2.7.a - Level 1b Full Swath Ortho-geolocated Product - ADS Tie Points Location & corresp. Aux. Data

A tie point annotation contains location and auxiliary data of the corresponding tie point as follows:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the measurement*	-	sl	3	12
2	12	*Attachment flag*	-	uc	1	1
3	13	latitude	(10-6)deg	sl	71	284
4	157	longitude	(10-6)deg	sl	71	284
5	301	DEM altitude	m	sl	71	284
6	445	DEM roughness	m	ul	71	284
7	589	DEM latitude correction	(10-6)deg	sl	71	284
8	733	DEM longitude correction	(10-6)deg	sl	71	284
9	877	sun zenith angle	(10-6)deg	ul	71	284
10	1021	sun azimuth angle	(10-6)deg	sl	71	284
11	1165	viewing zenith angle	(10-6)deg	ul	71	284
12	1309	viewing azimuth angle	(10-6)deg	sl	71	284
13	1453	zonal wind	m*s-1	ss	71	142
14	1525	meridional wind	m*s-1	ss	71	142
15	1597	atmospheric pressure	hPa	us	71	142
16	1669	ozone	DU	us	71	142
17	1741	relative humidity	%	us	71	142
		size (in bytes)	**-**	**-**	**-**	!Erreur de syntaxe,)

Table 4.3.2.7.b - Level 1b Full Swath Ortho-geolocated Product - ADSR Tie Points Location & corresp. Aux. Data

The elements of a tie point annotation has been specified as for the Level 1b Reduced Resolution Product, see [RD1] section 5.3.1.7.

5.2.8 - Measurement Data Sets MDS(1-16)

The Measurement Data Set format shall be as specified in [RD3].

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There are 19 measurement data sets, the first 15 consist of Top Of Atmosphere Radiances in mW/(m^2.sr.nm). There is one MDS for each of the MERIS spectral bands specified in the product SPH (fields 31, 32).

The full swath product corresponds to a footprint of 12865 (AL, max.) x 3700 (AC) FR pixels. There are therefore (up to) 12865 records for each MDS for the product. The data of the 3700 FR product pixels are stored in a single Measurement Data Set Record.

5.2.8.1 - Measurement Data Set Records MDS(1-15)

The MER_FSO_1P MDS(1-15) has been summarised below:

MDSR no	Description (for band b)	Size (bytes)
0	MDSR associated with line # 1	7413
1	MDSR associated with line # 2	7413
...	...	...
12864	MDSR associated with line # 12865	7413
	Total (in bytes)	**95368245**

Table 4.3.2.8.1.a - Level 1b Full Swath Ortho-geolocated Product - MDS(1-15)

Each MDSR(1-15) consists of 3700 elements as shown below:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the data Set Record*	mjd	sl	3	12
2	12	*Quality indicator*	-	sc	1	1
3	13	TOA radiances band b	LU	us	3700	7400
		MDSR size (in bytes)	**-**	**-**	**-**	**7413**

Table 4.3.2.8.1.b - Level 1b Full Resolution Product - MDSR(1-15)

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5.2.8.2 - Measurement Data Set Records MDS(16) Flags

A different MDS Record is associated to each frame.

The MER_FSO_1P MDS(16) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	3713
1	MDSR associated with line # 2	3713
...	...	...
12864	MDSR associated with line # 12865	3713
	Total (in bytes)	**47767745**

Table 4.3.2.8.2.a - Level 1b Full Swath Ortho-geolocated Product - MDS(16)

A MDSR contains the flags for each pixel of the corresponding product grid line.

Each MDSR(16) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Flags	nd	uc	3700	3700
		Data Base size (in bytes)	**-**	**-**	**-**	**3713**

Table 4.3.2.8.2.b - Level 1b Full Swath Ortho-geolocated Product - MDSR(16)

The flags are coded on a single bit according to table 4.3.2.8.2.c.

Flag type	bit number
cosmetic	0
duplicated	1
glint risk	2
suspect	3
land /ocean	4
bright	5
coastline	6
invalid	7

Table 4.3.2.8.2.c - Level 1b Full Swath Ortho-geolocated Product - Flags Coding

The bit numbering complies with the requirements defined in [RD1].

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5.2.8.3 - Measurement Data Set Records MDS(17) Longitude

A different MDS Record is associated to each frame.

The MER_FSO_1P MDS(17) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	14813
1	MDSR associated with line # 2	14813
...	...	...
12864	MDSR associated with line # 12865	14813
	Total (in bytes)	**190569245**

Table 4.3.2.8.3.a - Level 1b Full Swath Ortho-geolocated Product - MDS(16)

A MDSR contains the ortho-geolocated longitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Corrected Longitude	(10-6)deg	sl	3700	14800
		Data Base size (in bytes)	**-**	**-**	**-**	**14813**

Table 4.3.2.8.3.b - Level 1b Full Swath Ortho-geolocated Product - MDSR(17)

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5.2.8.4 - Measurement Data Set Records MDS(18) Latitude

A different MDS Record is associated to each frame.

The MER_FSO_1P MDS(18) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	14813
1	MDSR associated with line # 2	14813
...	...	...
12864	MDSR associated with line # 12865	14813
	Total (in bytes)	**173111440**

Table 4.3.2.8.3.a - Level 1b Full Swath Ortho-geolocated Product - MDS(18)

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Corrected Latitude	(10-6)deg	sl	3700	14800
		Data Base size (in bytes)	**-**	**-**	**-**	**14813**

Table 4.3.2.8.3.b - Level 1b Full Swath Ortho-geolocated Product - MDSR(17)

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5.2.8.5 - Measurement Data Set Records MDS(18) Altitude

A different MDS Record is associated to each frame.

The MER_FSO_1P MDS(18) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	7413
1	MDSR associated with line # 2	7413
...	...	...
12864	MDSR associated with line # 12865	7413
	Total (in bytes)	**95368245**

Table 4.3.2.8.3.a - Level 1b Full Swath Ortho-geolocated Product - MDS(18)

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Altitude	m	ss	3700	7400
		Data Base size (in bytes)	**-**	**-**	**-**	**7413**

Table 4.3.2.8.3.b - Level 1b Full Swath Ortho-geolocated Product - MDSR(17)

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5.3 MER_FSG_1P

5.3.1 - Summary

The Level 1b Full Swath Full Resolution GeoCorrected Product, hereafter referred to as Level 1b FSG, is summarised below:

Name	Level 1b full resolution GeoCorrected
Identifier	MER_FSG_1P
Product Level	1b
Description	Radiance measurements at top of atmosphere for the 15 MERIS bands, re-ordered, calibrated, radiometrically corrected, geo-located with orthorectification at pixel level, annotated with PCD, calibration data, classification flags, environment parameters
Coverage	Regional
Packaging	Segment (see definition in RD1, §2.4, here limited to a maximum duration of 7mn 33s or 10305 lines)
Unit	10^{-3} $W.m^{-2}.sr^{-1}.nm^{-1}$
Range	0..26 to 0..270 (band dependent)
Sampling	**spatial :** 260 m across track at nadir and 290 m along track. **spectral :** MERIS bands (see [RD1] Table 3.2.1)
Resolution	**radiometric :** NEDL (see [R-5] of [RD1])) **spatial :** MTF > 0.3 at Nyquist freq. ([R-5] of [RD1])) **spectral :** ≤ 2.5 nm ([R-5] of [RD1]))
Accuracy	**radiometric :** ≤ 2% in 400-900 nm range ([R-5] of [RD1])) **absolute geometric :** 2000m (spec. in [R-5] of [RD1])) **relative geometric :** 1000m (spec. in [R-5] of [RD1]))
Geo-location requirements	Each pixel is geo-located with orthorectification (i.e. accounting for the Earth surface elevation as provided by a Digital Elevation Model).
Format	• 16 bits/sample • 3700 samples/record • 19 records/line • up to 12865 lines/MDS • 1 GADS, 2 ADS & 19 MDS (15 for TOA LU, 1 for flags, 3 for longitudes, latitudes and altitudes)
Annotated data	see below
Frequency	Variable (upon Level 0 data availability and processing requests)
Size	1900 Mbytes per product (max)

Table 4.3.2.1 - Level 1b Full Swath GeoCorrected Product - Summary

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5.3.2 - Organization

The high-level breakdown of the Level 1-FSG product is described below:

Description	Size
Level 1b FSG - MPH	1247
Level 1b FSG - SPH	10782
Level 1b FSG Summary Quality ADS	693
Level 1b FSG GADS Scaling Factors	292
Level 1b FSG ADS Tie Points Location & Aux. Data	577206
Level 1b FSG MDS(1) TOA Radiances	92487375
Level 1b FSG MDS(2) TOA Radiances	92487375
Level 1b FSG MDS(3) TOA Radiances	92487375
Level 1b FSG MDS(4) TOA Radiances	92487375
Level 1b FSG MDS(5) TOA Radiances	92487375
Level 1b FSG MDS(6) TOA Radiances	92487375
Level 1b FSG MDS(7) TOA Radiances	92487375
Level 1b FSG MDS(8) TOA Radiances	92487375
Level 1b FSG MDS(9) TOA Radiances	92487375
Level 1b FSG MDS(10) TOA Radiances	92487375
Level 1b FSG MDS(11) TOA Radiances	92487375
Level 1b FSG MDS(12) TOA Radiances	92487375
Level 1b FSG MDS(13) TOA Radiances	92487375
Level 1b FSG MDS(14) TOA Radiances	92487375
Level 1b FSG MDS(15) TOA Radiances	92487375
Level 1b FSG MDS(16) Flags & Detector Index	138664080
Level 1b FSG MDS(17) Corrected Longitude	184840785
Level 1b FSG MDS(18) Corrected Latitude	184840785
Level 1b FSG MDS(19) Altitude	92487375
Product Size	**1988733870**

Table 4.3.2.2 - Level 1b Full Swath GeoCorrected Product - High-level breakdown

5.3.3 - Main Product Header

The format and the content of the Main Product Header shall be as specified in [RD3].

5.3.4 - Specific Product Header

The Specific Product Header format shall be as specified in [RD3].

The Data Set Descriptor format shall be as specified in [RD3].

The Level 1b Full Resolution Full Swath GeoCorrected Product Specific Product Header will be in ASCII format and its content shall be as follows:

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N	Byte #	Description	Unit	T	D	# Bytes
1	0	**SPH_DESCRIPTOR=**	keyword	uc	15	15
		quotation mark (“)	-	uc	1	1
		SPH Descriptor ASCII string describing the product.	-	uc	28	28
		quotation mark (“)	-	uc	1	1
		newline character	terminator	uc	1	1
2	46	**STRIPLINE_CONTINUITY_INDICATOR=**	keyword	uc	31	31
		Value: 0= No stripline continuity, the product is a complete segment Other: Stripline Counter	-	Ac	1	4
		newline character	terminator	uc	1	1
3	82	**SLICE_POSITION=**	keyword	uc	15	15
		Value: +001 to NUM_SLICES Default value if no stripline continuity = +001	-	Ac	1	4
		newline character	terminator	uc	1	1
4	102	**NUM_SLICES=**	keyword	uc	11	11
		Number of slices in this stripline Default value if no continuity = +001	-	Ac	1	4
		newline character	terminator	uc	1	1
		Product Time Information				
5	118	**FIRST_LINE_TIME=**	keyword	uc	16	16
		quotation mark (“)	-	uc	1	1
		Azimuth time first line of product. UTC Time of first range line in the MDS of this product. UTC time format contained within quotation marks.	UTC	uc	27	27
		quotation mark (“)	-	uc	1	1
		newline character	terminator	uc	1	1
6	164	**LAST_LINE_TIME=**	keyword	uc	15	15
		quotation mark (“)	-	uc	1	1
		Azimuth time last line of product Time of last range line in the MDS of this product. UTC time format contained within quotation marks.	UTC	uc	27	27
		quotation mark (“)	-	uc	1	1
		newline character	terminator	uc	1	1
		Product Positioning Information				
7	209	**FIRST_FIRST_LAT=**	keyword	uc	16	16
		Geodetic Latitude of the first sample of the first line A negative value denotes south latitude, a positive value denotes North latitude	10 -6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1

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8	247	**FIRST_FIRST_LONG=**	keyword	uc	17	17
		East geodetic longitude of the first sample of the first line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
9	286	**FIRST_MID_LAT=**	keyword	uc	14	14
		Geodetic Latitude of the middle sample of the first line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
10	322	**FIRST_MID_LONG=**	keyword	uc	15	15
		East geodetic longitude of the middle sample of the first line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
11	359	**FIRST_LAST_LAT=**	keyword	uc	15	15
		Geodetic Latitude of the last sample of the first line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
12	396	**FIRST_LAST_LONG=**	keyword	uc	16	16
		East geodetic longitude of the last sample of the first line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
13	434	**LAST_FIRST_LAT=**	keyword	uc	15	15
		Geodetic Latitude of the first sample of the last line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
14	471	**LAST_FIRST_LONG=**	keyword	uc	16	16
		East geodetic longitude of the first sample of the last line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
15	509	**LAST_MID_LAT=**	keyword	uc	13	13
		Geodetic Latitude of the middle sample of the last line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1

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16	544	**LAST_MID_LONG=**	keyword	uc	14	14
		East geodetic longitude of the middle sample of the last line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
17	580	**LAST_LAST_LAT=**	keyword	uc	14	14
		Geodetic Latitude of the last sample of the last line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
18	616	**LAST_LAST_LONG=**	keyword	uc	15	15
		East geodetic longitude of the last sample of the last line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
19	653	**Spare (blank characters)**	-	uc	47	47
		newline character	terminator	uc	1	1
		Product Quality Information				
20	701	**TRANS_ERR_FLAG=**	keyword	uc	15	15
		Set to 1 if number of transmission errors exceeds threshold. Set to 0 otherwise.	-	uc	1	1
		newline character	terminator	uc	1	1
21	718	**FORMAT_ERR_FLAG=**	keyword	uc	16	16
		Set to 1 if number of format errors exceeds threshold. Set to 0 otherwise.	-	uc	1	1
		newline character	terminator	uc	1	1
22	736	**DATABASE_FLAG=**	keyword	uc	14	14
		Flag set to 1 if the processing parameters data base contents does not match the packet header contents.	-	uc	1	1
		newline character	terminator	uc	1	1
23	752	**COARSE_ERR_FLAG=**	keyword	uc	16	16
		Flag indicating coarse offsets are above threshold	-	uc	1	1
		newline character	terminator	uc	1	1
24	770	**ECMWF_TYPE=**	keyword	uc	11	11
		0 = forecast ECMWF data was used 1 = analysis ECMWF data was used	-	uc	1	1
		newline character	terminator	uc	1	1
25	783	**NUM_TRANS_ERR=**	keyword	uc	14	14
		Number of transmission errors in the product	-	A1	1	11
		newline character	terminator	uc	1	1
26	809	**NUM_FORMAT_ERR=**	keyword	uc	15	15
		Number of format errors in the product	-	A1	1	11
		newline character	terminator	uc	1	1
27	836	**TRANS_ERR_THRESH=**	keyword	uc	17	17
		Threshold for setting TRANS_ERR_FLAG	%	Afl	1	15
		<%>	units	uc	3	3
		newline character	terminator	uc	1	1

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28	872	**FORMAT_ERR_THRESH=**	keyword	uc	18	18
		Threshold for setting FORMAT_ERR_FLAG	%	Afl	1	15
		<%>	units	uc	3	3
		newline character	terminator	uc	1	1
29	909	**Spare (blank characters)**	-	uc	77	77
		newline character	terminator	uc	1	1
		Additional Product Information				
30	987	**NUM_BANDS=**	keyword	uc	10	10
		Number of bands in the product	-	Ac	1	4
		newline character	terminator	uc	1	1
31	1002	**BAND_WAVELEN=**	keyword	uc	13	13
		List of up to 15 band central wavelengths of the bands contained in this product. Unused values are set to zero.	10-3 nm	Al	15	165
		<10-5nm>	units	uc	8	8
		newline character	terminator	uc	1	1
32	1189	**BANDWIDTH=**	keyword	uc	10	10
		List of up to 15 bandwidths for the bands in the product. The order of the list must match the order of the central wavelengths entries in the previous field. Unused values are set to zero. Each entry is of the form Al. e.g., if only 13 bands were included in the product: +10000+10000+10000+10000+10000+10000+10000+07500+02500+05000+12500+10000+12500+00000+00000	10-3 nm	As	15	90
		<10-3nm>	units	uc	8	8
		newline character	terminator	uc	1	1
33	1198	**INST_FOV=**	keyword	uc	9	9
		Instantaneous Field of View	10-6 deg	Al	1	11
		<10-6deg>	units	uc	9	9
		newline character	terminator	uc	1	1
34	1328	**PROC_MODE=**	keyword	uc	10	10
		Processor mode of operation 1 = Raw 0 = Full Processing	flag	uc	1	1
		newline character	terminator	uc	1	1
35	1340	**OFFSET_COMP=**	keyword	uc	12	12
		Offset Compensation 1=ON 0=OFF	flag	uc	1	1
		newline character	terminator	uc	1	1
36	1354	**LINE_TIME_INTERVAL=**	keyword	uc	19	19
		Line spacing in time	(10-6) sec	Al	1	11
		<10-6s>	units	uc	7	7
		newline character	terminator	uc	1	1
37	1392	**LINE_LENGTH=**	keyword	uc	12	12
		Number of samples per output line	samples	As	1	6
		<samples>	units	uc	9	9
		newline character	terminator	uc	1	1
38	1420	**LINES_PER_TIE_PT=**	keyword	uc	17	17
		Number of lines between along track tie points	lines	Ac	1	4
		newline character	terminator	uc	1	1

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39	1442	**SAMPLES_PER_TIE_PT=**	keyword	uc	19	19
		Number of samples between across track tie points	samples	Ac	1	4
		newline character	terminator	uc	1	1
40	1466	**COLUMN_SPACING=**	keyword	uc	15	15
		On ground spacing between columns	m	Afl	1	15
		<m>	units	uc	3	3
		newline character	terminator	uc	1	1
41	1500	**Spare (blank characters)**	-	uc	41	41
		newline character	terminator	uc	1	1
		DSDs for included Data Sets				
42	1542	**DSD-A of Level 1b Summary Quality ADS (SQADS)**	-	dsd	1	280
43	1822	**DSD-G of Level 1b Scaling Factors and General info GADS**	-	dsd	1	280
44	2102	**DSD-A of Level 1b Tie Points Loc. & Aux. Data ADS**	-	dsd	1	280
45	2382	**DSD-M(1-15) of Level 1b TOA Radiances MDSs**	-	dsd	15	4200
46	6582	**DSD-M(16) of Level 1b Flags & Detector Index**	-	dsd	1	280
46	6582	**DSD-M(17) of Level 1b Corrected Longitude**	-	dsd	1	280
46	6582	**DSD-M(18) of Level 1b Corrected Latitude**	-	dsd	1	280
46	6582	**DSD-M(19) of Level 1b Altitude**	-	dsd	1	280
		DSDs for referenced Data Sets				
47	6862	**DSD-R Level 0 data file**	-	dsd	1	280
48	7142	**DSD-R Instrument auxiliary data file**	-	dsd	1	280
49	7422	**DSD-R Proc. L1b control parameters data file**	-	dsd	1	280
50	7702	**DSD-R Radiometric calibration data file**	-	dsd	1	280
51	7982	**DSD-R Digital Elevation Model data file**	-	dsd	1	280
52	8262	**DSD-R Digital Roughness Model data file**	-	dsd	1	280
53	8542	**DSD-R Coast-line/Land/Ocean file**	-	dsd	1	280
54	8822	**DSD -R for ECMWF files used**	-	dsd	1	280
55	9102	**DSD- R for Orbit State Vectors Used**	-	dsd	1	280
56	9382	**DSD-R Platform Attitude data file (CFI software)**	-	dsd	1	280
57	9662	**DSD-R High Resolution Digital Elevation Model**	-	dsd	1	280
		size (in bytes)				**10782**

Table 5.3.1.4 - Level 1b Full Swath GeoCorrected Product - SPH

All Data Set Descriptors (DSD) shall follow the format and have the content described in [RD3].

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5.3.5 - Annotation Data Set - Summary Quality

The Annotation Data Set format shall be as specified in [RD3].

This ADS contains only data useful for the evaluation of the quality of the product. It shall have one ADS Record for every new group of 8 tie frames (a new record has to be generated when starting the 9th tie frame, the last Summary Quality record of the product may be relevant for less than 8 tie frames), therefore it will hold (up to) 21 Records in the Full swath GeoCorrected product.
In the MER_FSG_1P generation process, these data are not re-evaluated but copied from the input product. In the case of a partial processing, even if the first MDS record does belongs to the first ADS Summary Quality record, it may not correspond to its start limit. In other words synchronisation between ADS Summary Quality and MDS may be lost and corresponding information is only partially relevant.

The size of the ADS has been summarised below:

ADSR no	Description	Size (bytes)
0	ADSR associated with line # 1 - 512 FR pixels	33
1	ADSR associated with line # 513 - 1024 FR pixels	33
...	...	...
20	ADSR associated with line # 9794 - 10305 FR pixels	33
	Total (in bytes)	**693**

Table 4.3.2.5 - Level 1b Full Swath GeoCorrected Product - Summary Quality ADS

The format and content of the Summary Quality ADSR is identical to the Level 1b Reduced Resolution Product Summary Quality ADSR described in § 5.3.1.5 of [RD1].

5.3.6 - Global Annotation Data Set - Scaling Factors

The Global Annotation Data Set format shall be as specified in [RD3].

The content of the GADS- Scaling Factors of the Level 1b Full Swath GeoCorrected Product is identical to the Level 1b Reduced Resolution Product GADS- Scaling Factors described in § 5.3.1.6 of [RD1] .

5.3.7 - Annotation Data Set - Tie Points Location & corresp. Aux. Data

The Annotation Data Set format shall be as specified in [RD3].

The tie point separation of the Full Swath GeoCorrected product will be identical to that of the reduced resolution spacing on ground (kilometres). This is equivalent to a tie point every 64 FR-pixels in the across track direction and 64 lines in the along track direction.
With the tie point grid being a 64 x 64 sub grid of the FSG product grid consisting of 10305 (AL) x 4481 (AC) pixels, there are 162*71 (AL*AC) tie points. There are therefore (up to) 162 tie points Annotation Data Sets Records for the MER_FSG_1P Product.

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Each ADS is made of ADS Records (one ADSR for each line of the tie points grid, see section 4.2 of [RD1]), the size of the ADS has been summarised below:

ADSR no	Description	Size
0	ADSR # 1	3563
1	ADSR # 2	3563
...	...	...
161	ADSR # 162	3563
	Total (in bytes)	**577206**

Table 4.3.2.7.a - Level 1b Full Swath GeoCorrected Product - ADS Tie Points Location & corresp. Aux. Data

A tie point annotation contains location and auxiliary data of the corresponding tie point as follows:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the measurement*	-	sl	3	12
2	12	*Attachment flag*	-	uc	1	1
3	13	latitude	(10-6)deg	sl	71	284
4	157	longitude	(10-6)deg	sl	71	284
5	301	DEM altitude	m	sl	71	284
6	445	DEM roughness	m	ul	71	284
7	589	DEM latitude correction	(10-6)deg	sl	71	284
8	733	DEM longitude correction	(10-6)deg	sl	71	284
9	877	sun zenith angle	(10-6)deg	ul	71	284
10	1021	sun azimuth angle	(10-6)deg	sl	71	284
11	1165	viewing zenith angle	(10-6)deg	ul	71	284
12	1309	viewing azimuth angle	(10-6)deg	sl	71	284
13	1453	zonal wind	m*s-1	ss	71	142
14	1525	meridional wind	m*s-1	ss	71	142
15	1597	atmospheric pressure	hPa	us	71	142
16	1669	ozone	DU	us	71	142
17	1741	relative humidity	%	us	71	142
		size (in bytes)	-	-	-	!Erreur de syntaxe,)

Table 4.3.2.7.b - Level 1b Full Swath GeoCorrected Product - ADSR Tie Points Location & corresp. Aux. Data

The elements of a tie point annotation has been specified as for the Level 1b Reduced Resolution Product, see [RD1] section 5.3.1.7.

5.3.8 - Measurement Data Sets MDS(1-16)

The Measurement Data Set format shall be as specified in [RD3].

There are 19 measurement data sets, the first 15 consist of Top Of Atmosphere Radiances in mW/(m^2.sr.nm). There is one MDS for each of the MERIS spectral bands specified in the product SPH (fields 31, 32).

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The full swath product corresponds to a footprint of 10305 (AL, max.) x 4481 (AC) FR pixels. There are therefore (up to) 10305 records for each MDS for the product. The data of the 4481 FR product pixels are stored in a single Measurement Data Set Record.

5.3.8.1 - Measurement Data Set Records MDS(1-15)

The MER_FSO_1P MDS(1-15) has been summarised below:

MDSR no	Description (for band b)	Size (bytes)
0	MDSR associated with line # 1	8975
1	MDSR associated with line # 2	8975
...	...	...
10304	MDSR associated with line # 10305	8975
	Total (in bytes)	**92487375**

Table 4.3.2.8.1.a - Level 1b Full Swath GeoCorrected Product - MDS(1-15)

Each MDSR(1-15) consists of 4481 elements as shown below:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the data Set Record*	mjd	sl	3	12
2	12	*Quality indicator*	-	sc	1	1
3	13	TOA radiances band b	LU	us	4481	8962
		MDSR size (in bytes)	**-**	**-**	**-**	**8975**

Table 4.3.2.8.1.b - Level 1b Full Swath GeoCorrected Product - MDSR(1-15)

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5.3.8.2 - Measurement Data Set Records MDS(16) Flags

A different MDS Record is associated to each frame.

The MER_FSG_1P MDS(16) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	6736
1	MDSR associated with line # 2	6736
...	...	...
10304	MDSR associated with line # 10305	6736
	Total (in bytes)	**138664080**

Table 4.3.2.8.2.a - Level 1b Full Swath GeoCorrected Product - MDS(16)

A MDSR contains the flags for each pixel of the corresponding product grid line.

Each MDSR(16) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Flags	nd	uc	4481	4481
4	4494	Detector Index	nd	ss	4481	8962
		Data Base size (in bytes)	**-**	**-**	**-**	**13456**

Table 4.3.2.8.2.b - Level 1b Full Swath GeoCorrected Product - MDSR(16)

The flags are coded on a single bit according to table 4.3.2.8.2.c. The Detector index allows to link each product pixel to the instrument detector using indexing as described in [R-6] of [RD1].

Flag type	bit number
cosmetic	0
duplicated	1
glint risk	2
suspect	3
land /ocean	4
bright	5
coastline	6
invalid	7

Table 4.3.2.8.2.c - Level 1b Full Swath GeoCorrected Product - Flags Coding

The bit numbering complies with the requirements defined in [RD1].

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5.3.8.3 - Measurement Data Set Records MDS(17) Longitude

A different MDS Record is associated to each frame.

The MER_FSG_1P MDS(17) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	17937
1	MDSR associated with line # 2	17937
...	...	...
10304	MDSR associated with line # 10305	17937
	Total (in bytes)	**184840785**

Table 4.3.2.8.3.a - Level 1b Full Swath GeoCorrected Product - MDS(16)

A MDSR contains the ortho-geolocated longitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Corrected Longitude	(10-6)deg	sl	4481	17924
		Data Base size (in bytes)	**-**	**-**	**-**	**17937**

Table 4.3.2.8.3.b - Level 1b Full Swath GeoCorrected Product - MDSR(17)

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5.3.8.4 - Measurement Data Set Records MDS(18) Latitude

A different MDS Record is associated to each frame.

The MER_FSG_1P MDS(18) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	17937
1	MDSR associated with line # 2	17937
...	...	...
10304	MDSR associated with line # 10305	17937
	Total (in bytes)	**184840785**

Table 4.3.2.8.3.a - Level 1b Full Swath GeoCorrected Product - MDS(18)

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Corrected Latitude	(10-6)deg	sl	4481	17924
		Data Base size (in bytes)	**-**	**-**	**-**	**17937**

Table 4.3.2.8.3.b - Level 1b Full Swath GeoCorrected Product - MDSR(17)

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5.3.8.5 - Measurement Data Set Records MDS(18) Altitude

A different MDS Record is associated to each frame.

The MER_FSG_1P MDS(18) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	8975
1	MDSR associated with line # 2	8975
...	...	...
10304	MDSR associated with line # 10305	8975
	Total (in bytes)	**92487375**

Table 4.3.2.8.3.a - Level 1b Full Swath GeoCorrected Product - MDS(18)

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Altitude	m	ss	4481	8962
		Data Base size (in bytes)	**-**	**-**	**-**	**8975**

Table 4.3.2.8.3.b - Level 1b Full Swath GeoCorrected Product - MDSR(17)

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5.4 MER_FRG_1P

5.4.1 - Summary

The Level 1b Full Resolution GeoCorrected Product, hereafter referred to as Level 1b FRG, is summarised below:

Name	Level 1b full resolution GeoCorrected
Identifier	MER_FRG_1P
Product Level	1b
Description	Radiance measurements at top of atmosphere for the 15 MERIS bands, re-ordered, calibrated, radiometrically corrected, geo-located with orthorectification at pixel level, annotated with PCD, calibration data, classification flags, environment parameters
Coverage	Regional
Packaging	Scene of 2241 lines
Unit	10^{-3} W.m^{-2}.sr^{-1}.nm^{-1}
Range	0..26 to 0..270 (band dependent)
Sampling	**spatial :** 260 m across track at nadir and 290 m along track. **spectral :** MERIS bands (see [RD1] Table 3.2.1)
Resolution	**radiometric :** NEDL (see [R-5] of [RD1])) **spatial :** MTF > 0.3 at Nyquist freq. ([R-5] of [RD1])) **spectral :** ≤ 2.5 nm ([R-5] of [RD1]))
Accuracy	**radiometric :** ≤ 2% in 400-900 nm range ([R-5] of [RD1])) **absolute geometric :** 2000m (spec. in [R-5] of [RD1])) **relative geometric :** 1000m (spec. in [R-5] of [RD1]))
Geo-location requirements	Each pixel is geo-located with orthorectification (i.e. accounting for the Earth surface elevation as provided by a Digital Elevation Model).
Format	• 16 bits/sample • 2241 samples/record • 19 records/line • 2241 lines/MDS • 1 GADS, 2 ADS & 19 MDS (15 for TOA LU, 1 for flags, 3 for longitudes, latitudes and altitudes)
Annotated data	see below
Frequency	Variable (upon Level 0 data availability and processing requests)
Size	206 Mbytes

Table 4.3.2.1 - Level 1b Full Resolution GeoCorrected Product - Summary

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5.4.2 - Organization

The high-level breakdown of the Level 1-FRG product is described below:

Description	Size
Level 1b FSG - MPH	1247
Level 1b FSG - SPH	10782
Level 1b FSG Summary Quality ADS	165
Level 1b FSG GADS Scaling Factors	292
Level 1b FSG ADS Tie Points Location & Aux. Data	65268
Level 1b FSG MDS(1) TOA Radiances	10073295
Level 1b FSG MDS(2) TOA Radiances	10073295
Level 1b FSG MDS(3) TOA Radiances	10073295
Level 1b FSG MDS(4) TOA Radiances	10073295
Level 1b FSG MDS(5) TOA Radiances	10073295
Level 1b FSG MDS(6) TOA Radiances	10073295
Level 1b FSG MDS(7) TOA Radiances	10073295
Level 1b FSG MDS(8) TOA Radiances	10073295
Level 1b FSG MDS(9) TOA Radiances	10073295
Level 1b FSG MDS(10) TOA Radiances	10073295
Level 1b FSG MDS(11) TOA Radiances	10073295
Level 1b FSG MDS(12) TOA Radiances	10073295
Level 1b FSG MDS(13) TOA Radiances	10073295
Level 1b FSG MDS(14) TOA Radiances	10073295
Level 1b FSG MDS(15) TOA Radiances	10073295
Level 1b FSG MDS(16) Flags & Detector Index	15095376
Level 1b FSG MDS(17) Corrected Longitude	20117457
Level 1b FSG MDS(18) Corrected Latitude	20117457
Level 1b FSG MDS(19) Altitude	10073295
Product Size	**216580764**

Table 4.3.2.2 - Level 1b Full Resolution GeoCorrected Product - High-level breakdown

5.4.3 - Main Product Header

The format and the content of the Main Product Header shall be as specified in [RD3].

5.4.4 - Specific Product Header

The Specific Product Header format shall be as specified in [RD3].

The Data Set Descriptor format shall be as specified in [RD3].

The Level 1b Full Resolution GeoCorrected Product Specific Product Header will be in ASCII format and its content shall be as follows:

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N	Byte #	Description	Unit	T	D	# Bytes
1	0	**SPH_DESCRIPTOR=**	keyword	uc	15	15
		quotation mark (“)	-	uc	1	1
		SPH Descriptor ASCII string describing the product.	-	uc	28	28
		quotation mark (“)	-	uc	1	1
		newline character	terminator	uc	1	1
2	46	**STRIPLINE_CONTINUITY_INDICATOR=**	keyword	uc	31	31
		Value: 0= No stripline continuity, the product is a complete segment Other: Stripline Counter	-	Ac	1	4
		newline character	terminator	uc	1	1
3	82	**SLICE_POSITION=**	keyword	uc	15	15
		Value: +001 to NUM_SLICES Default value if no stripline continuity = +001	-	Ac	1	4
		newline character	terminator	uc	1	1
4	102	**NUM_SLICES=**	keyword	uc	11	11
		Number of slices in this stripline Default value if no continuity = +001	-	Ac	1	4
		newline character	terminator	uc	1	1
		Product Time Information				
5	118	**FIRST_LINE_TIME=**	keyword	uc	16	16
		quotation mark (“)	-	uc	1	1
		Azimuth time first line of product. UTC Time of first range line in the MDS of this product. UTC time format contained within quotation marks.	UTC	uc	27	27
		quotation mark (“)	-	uc	1	1
		newline character	terminator	uc	1	1
6	164	**LAST_LINE_TIME=**	keyword	uc	15	15
		quotation mark (“)	-	uc	1	1
		Azimuth time last line of product Time of last range line in the MDS of this product. UTC time format contained within quotation marks.	UTC	uc	27	27
		quotation mark (“)	-	uc	1	1
		newline character	terminator	uc	1	1
		Product Positioning Information				
7	209	**FIRST_FIRST_LAT=**	keyword	uc	16	16
		Geodetic Latitude of the first sample of the first line A negative value denotes south latitude, a positive value denotes North latitude	10 -6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1

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8	247	**FIRST_FIRST_LONG=**	keyword	uc	17	17
		East geodetic longitude of the first sample of the first line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
9	286	**FIRST_MID_LAT=**	keyword	uc	14	14
		Geodetic Latitude of the middle sample of the first line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
10	322	**FIRST_MID_LONG=**	keyword	uc	15	15
		East geodetic longitude of the middle sample of the first line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
11	359	**FIRST_LAST_LAT=**	keyword	uc	15	15
		Geodetic Latitude of the last sample of the first line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
12	396	**FIRST_LAST_LONG=**	keyword	uc	16	16
		East geodetic longitude of the last sample of the first line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
13	434	**LAST_FIRST_LAT=**	keyword	uc	15	15
		Geodetic Latitude of the first sample of the last line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
14	471	**LAST_FIRST_LONG=**	keyword	uc	16	16
		East geodetic longitude of the first sample of the last line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
15	509	**LAST_MID_LAT=**	keyword	uc	13	13
		Geodetic Latitude of the middle sample of the last line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1

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16	544	**LAST_MID_LONG=**	keyword	uc	14	14
		East geodetic longitude of the middle sample of the last line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
17	580	**LAST_LAST_LAT=**	keyword	uc	14	14
		Geodetic Latitude of the last sample of the last line A negative value denotes south latitude, a positive value denotes North latitude	10-6 degrees	Al	1	11
		<10-6degN>	units	uc	10	10
		newline character	terminator	uc	1	1
18	616	**LAST_LAST_LONG=**	keyword	uc	15	15
		East geodetic longitude of the last sample of the last line.Positive values East of Greenwich, negative values west of Greenwich.	10-6 degrees	Al	1	11
		<10-6degE>	units	uc	10	10
		newline character	terminator	uc	1	1
19	653	**Spare (blank characters)**	-	uc	47	47
		newline character	terminator	uc	1	1
		Product Quality Information				
20	701	**TRANS_ERR_FLAG=**	keyword	uc	15	15
		Set to 1 if number of transmission errors exceeds threshold. Set to 0 otherwise.	-	uc	1	1
		newline character	terminator	uc	1	1
21	718	**FORMAT_ERR_FLAG=**	keyword	uc	16	16
		Set to 1 if number of format errors exceeds threshold. Set to 0 otherwise.	-	uc	1	1
		newline character	terminator	uc	1	1
22	736	**DATABASE_FLAG=**	keyword	uc	14	14
		Flag set to 1 if the processing parameters data base contents does not match the packet header contents.	-	uc	1	1
		newline character	terminator	uc	1	1
23	752	**COARSE_ERR_FLAG=**	keyword	uc	16	16
		Flag indicating coarse offsets are above threshold	-	uc	1	1
		newline character	terminator	uc	1	1
24	770	**ECMWF_TYPE=**	keyword	uc	11	11
		0 = forecast ECMWF data was used 1 = analysis ECMWF data was used	-	uc	1	1
		newline character	terminator	uc	1	1
25	783	**NUM_TRANS_ERR=**	keyword	uc	14	14
		Number of transmission errors in the product	-	A1	1	11
		newline character	terminator	uc	1	1
26	809	**NUM_FORMAT_ERR=**	keyword	uc	15	15
		Number of format errors in the product	-	A1	1	11
		newline character	terminator	uc	1	1
27	836	**TRANS_ERR_THRESH=**	keyword	uc	17	17
		Threshold for setting TRANS_ERR_FLAG	%	Afl	1	15
		<%>	units	uc	3	3
		newline character	terminator	uc	1	1

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28	872	**FORMAT_ERR_THRESH=**	keyword	uc	18	18
		Threshold for setting FORMAT_ERR_FLAG	%	Afl	1	15
		<%>	units	uc	3	3
		newline character	terminator	uc	1	1
29	909	**Spare (blank characters)**	-	uc	77	77
		newline character	terminator	uc	1	1
		Additional Product Information				
30	987	**NUM_BANDS=**	keyword	uc	10	10
		Number of bands in the product	-	Ac	1	4
		newline character	terminator	uc	1	1
31	1002	**BAND_WAVELEN=**	keyword	uc	13	13
		List of up to 15 band central wavelengths of the bands contained in this product. Unused values are set to zero.	10-3 nm	Al	15	165
		<10-5nm>	units	uc	8	8
		newline character	terminator	uc	1	1
32	1189	**BANDWIDTH=**	keyword	uc	10	10
		List of up to 15 bandwidths for the bands in the product. The order of the list must match the order of the central wavelengths entries in the previous field. Unused values are set to zero. Each entry is of the form Al. e.g., if only 13 bands were included in the product: +10000+10000+10000+10000+10000+10000+10000+07500+02500+05000+12500+10000+12500+00000+00000	10-3 nm	As	15	90
		<10-3nm>	units	uc	8	8
		newline character	terminator	uc	1	1
33	1198	**INST_FOV=**	keyword	uc	9	9
		Instantaneous Field of View	10-6 deg	Al	1	11
		<10-6deg>	units	uc	9	9
		newline character	terminator	uc	1	1
34	1328	**PROC_MODE=**	keyword	uc	10	10
		Processor mode of operation 1 = Raw 0 = Full Processing	flag	uc	1	1
		newline character	terminator	uc	1	1
35	1340	**OFFSET_COMP=**	keyword	uc	12	12
		Offset Compensation 1=ON 0=OFF	flag	uc	1	1
		newline character	terminator	uc	1	1
36	1354	**LINE_TIME_INTERVAL=**	keyword	uc	19	19
		Line spacing in time	(10-6) sec	Al	1	11
		<10-6s>	units	uc	7	7
		newline character	terminator	uc	1	1
37	1392	**LINE_LENGTH=**	keyword	uc	12	12
		Number of samples per output line	samples	As	1	6
		<samples>	units	uc	9	9
		newline character	terminator	uc	1	1
38	1420	**LINES_PER_TIE_PT=**	keyword	uc	17	17
		Number of lines between along track tie points	lines	Ac	1	4
		newline character	terminator	uc	1	1

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39	1442	**SAMPLES_PER_TIE_PT=**	keyword	uc	19	19
		Number of samples between across track tie points	samples	Ac	1	4
		newline character	terminator	uc	1	1
40	1466	**COLUMN_SPACING=**	keyword	uc	15	15
		On ground spacing between columns	m	Afl	1	15
		<m>	units	uc	3	3
		newline character	terminator	uc	1	1
41	1500	**Spare (blank characters)**	-	uc	41	41
		newline character	terminator	uc	1	1
		DSDs for included Data Sets				
42	1542	**DSD-A of Level 1b Summary Quality ADS (SQADS)**	-	dsd	1	280
43	1822	**DSD-G of Level 1b Scaling Factors and General info GADS**	-	dsd	1	280
44	2102	**DSD-A of Level 1b Tie Points Loc. & Aux. Data ADS**	-	dsd	1	280
45	2382	**DSD-M(1-15) of Level 1b TOA Radiances MDSs**	-	dsd	15	4200
46	6582	**DSD-M(16) of Level 1b Flags & Detector Index**	-	dsd	1	280
46	6582	**DSD-M(17) of Level 1b Corrected Longitude**	-	dsd	1	280
46	6582	**DSD-M(18) of Level 1b Corrected Latitude**	-	dsd	1	280
46	6582	**DSD-M(19) of Level 1b Altitude**	-	dsd	1	280
		DSDs for referenced Data Sets				
47	6862	**DSD-R Level 0 data file**	-	dsd	1	280
48	7142	**DSD-R Instrument auxiliary data file**	-	dsd	1	280
49	7422	**DSD-R Proc. L1b control parameters data file**	-	dsd	1	280
50	7702	**DSD-R Radiometric calibration data file**	-	dsd	1	280
51	7982	**DSD-R Digital Elevation Model data file**	-	dsd	1	280
52	8262	**DSD-R Digital Roughness Model data file**	-	dsd	1	280
53	8542	**DSD-R Coast-line/Land/Ocean file**	-	dsd	1	280
54	8822	**DSD -R for ECMWF files used**	-	dsd	1	280
55	9102	**DSD- R for Orbit State Vectors Used**	-	dsd	1	280
56	9382	**DSD-R Platform Attitude data file (CFI software)**	-	dsd	1	280
57	9662	**DSD-R High Resolution Digital Elevation Model**	-	dsd	1	280
		size (in bytes)				**10782**

Table 5.3.1.4 - Level 1b Full Resolution GeoCorrected Product - SPH

All Data Set Descriptors (DSD) shall follow the format and have the content described in [RD3].

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5.4.5 - Annotation Data Set - Summary Quality

The Annotation Data Set format shall be as specified in [RD3].

This ADS contains only data useful for the evaluation of the quality of the product. It shall have one ADS Record for every new group of 8 tie frames (a new record has to be generated when starting the 9th tie frame, the last Summary Quality record of the product may be relevant for less than 8 tie frames), therefore it will hold 5 Records in the Full resolution GeoCorrected product.

The size of the ADS has been summarised below:

ADSR no	Description	Size (bytes)
0	ADSR associated with line # 1 - 512 FR pixels	33
1	ADSR associated with line # 513 - 1024 FR pixels	33
...	...	...
4	ADSR associated with line # 2049 - 2241 FR pixels	33
	Total (in bytes)	**165**

Table 4.3.2.5 - Level 1b Full Resolution GeoCorrected Product - Summary Quality ADS

The format and content of the Summary Quality ADSR is identical to the Level 1b Reduced Resolution Product Summary Quality ADSR described in § 5.3.1.5 of [RD1].

5.4.6 - Global Annotation Data Set - Scaling Factors

The Global Annotation Data Set format shall be as specified in [RD3].

The content of the GADS- Scaling Factors of the Level 1b Full Resolution GeoCorrected Product is identical to the Level 1b Reduced Resolution Product GADS- Scaling Factors described in § 5.3.1.6 of [RD1] .

5.4.7 - Annotation Data Set - Tie Points Location & corresp. Aux. Data

The Annotation Data Set format shall be as specified in [RD3].

The tie point separation of the Full Resolution GeoCorrected product will be identical to that of the reduced resolution spacing on ground (kilometres). This is equivalent to a tie point every 64 FR-pixels in the across track direction and 64 lines in the along track direction.
With the tie point grid being a 64 x 64 sub grid of the FRG product grid consisting of 2241 (AL) x 2241 (AC) pixels, there are 36*36 (AL*AC) tie points. There are therefore 36 tie points Annotation Data Sets Records for the MER_FRG_1P Product.
Each ADS is made of ADS Records (one ADSR for each line of the tie points grid, see section 4.2 of [RD1]), the size of the ADS has been summarised below:

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ADSR no	Description	Size
0	ADSR # 1	1813
1	ADSR # 2	1813
...	...	...
35	ADSR # 36	1813
	Total (in bytes)	**65268**

Table 4.3.2.7.a - Level 1b Full Resolution GeoCorrected Product - ADS Tie Points Location & corresp. Aux. Data

A tie point annotation contains location and auxiliary data of the corresponding tie point as follows:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the measurement*	-	sl	3	12
2	12	*Attachment flag*	-	uc	1	1
3	13	latitude	(10-6)deg	sl	36	144
4	157	longitude	(10-6)deg	sl	36	144
5	301	DEM altitude	m	sl	36	144
6	445	DEM roughness	m	ul	36	144
7	589	DEM latitude correction	(10-6)deg	sl	36	144
8	733	DEM longitude correction	(10-6)deg	sl	36	144
9	877	sun zenith angle	(10-6)deg	ul	36	144
10	1021	sun azimuth angle	(10-6)deg	sl	36	144
11	1165	viewing zenith angle	(10-6)deg	ul	36	144
12	1309	viewing azimuth angle	(10-6)deg	sl	36	144
13	1453	zonal wind	m*s-1	ss	36	72
14	1525	meridional wind	m*s-1	ss	36	72
15	1597	atmospheric pressure	hPa	us	36	72
16	1669	ozone	DU	us	36	72
17	1741	relative humidity	%	us	36	72
		size (in bytes)	**-**	**-**	**-**	**1813**

Table 4.3.2.7.b - Level 1b Full Resolution GeoCorrected Product - ADSR Tie Points Location & corresp. Aux. Data

The elements of a tie point annotation has been specified as for the Level 1b Reduced Resolution Product, see [RD1] section 5.3.1.7.

5.4.8 - Measurement Data Sets MDS(1-16)

The Measurement Data Set format shall be as specified in [RD3].

There are 19 measurement data sets, the first 15 consist of Top Of Atmosphere Radiances in mW/(m^2.sr.nm). There is one MDS for each of the MERIS spectral bands specified in the product SPH (fields 31, 32).

The full swath product corresponds to a footprint of 2241 (AL) x 2241 (AC) FR pixels.
There are therefore 2241 records for each MDS for the product. The data of the 2241 FR product pixels are stored in a single Measurement Data Set Record.

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5.4.8.1 - Measurement Data Set Records MDS(1-15)

The MER_FRG_1P MDS(1-15) has been summarised below:

MDSR no	Description (for band b)	Size (bytes)
0	MDSR associated with line # 1	4495
1	MDSR associated with line # 2	4495
...	...	...
2240	MDSR associated with line # 2041	4495
	Total (in bytes)	**10073295**

Table 4.3.2.8.1.a - Level 1b Full Resolution GeoCorrected Product - MDS(1-15)

Each MDSR(1-15) consists of 2241 elements as shown below:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the data Set Record*	mjd	sl	3	12
2	12	*Quality indicator*	-	sc	1	1
3	13	TOA radiances band b	LU	us	2241	4482
		MDSR size (in bytes)	**-**	**-**	**-**	**4495**

Table 4.3.2.8.1.b - Level 1b Full Resolution GeoCorrected Product - MDSR(1-15)

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5.4.8.2 - Measurement Data Set Records MDS(16) Flags

A different MDS Record is associated to each frame.

The MER_FRG_1P MDS(16) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	6736
1	MDSR associated with line # 2	6736
...	...	...
2240	MDSR associated with line # 2241	6736
	Total (in bytes)	**15095376**

Table 4.3.2.8.2.a - Level 1b Full Resolution GeoCorrected Product - MDS(16)

A MDSR contains the flags for each pixel of the corresponding product grid line.

Each MDSR(16) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Flags	nd	uc	2241	2241
4	4494	Detector Index	nd	ss	2241	4482
		Data Base size (in bytes)	**-**	**-**	**-**	**6736**

Table 4.3.2.8.2.b - Level 1b Full Resolution GeoCorrected Product - MDSR(16)

The flags are coded on a single bit according to table 4.3.2.8.2.c. The Detector index allows to link each product pixel to the instrument detector using indexing as described in [R-6] of [RD1].

Flag type	bit number
cosmetic	0
duplicated	1
glint risk	2
suspect	3
land /ocean	4
bright	5
coastline	6
invalid	7

Table 4.3.2.8.2.c - Level 1b Full Resolution GeoCorrected Product - Flags Coding

The bit numbering complies with the requirements defined in [RD1].

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5.4.8.3 - Measurement Data Set Records MDS(17) Longitude

A different MDS Record is associated to each frame.

The MER_FRG_1P MDS(17) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	8977
1	MDSR associated with line # 2	8977
...	...	...
2240	MDSR associated with line # 2041	8977
	Total (in bytes)	**20117457**

Table 4.3.2.8.3.a - Level 1b Full Resolution GeoCorrected Product - MDS(16)

A MDSR contains the ortho-geolocated longitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Corrected Longitude	(10-6)deg	sl	2241	8964
		Data Base size (in bytes)	**-**	**-**	**-**	**8977**

Table 4.3.2.8.3.b - Level 1b Full Resolution GeoCorrected Product - MDSR(17)

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5.4.8.4 - Measurement Data Set Records MDS(18) Latitude

A different MDS Record is associated to each frame.

The MER_FRG_1P MDS(18) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	8977
1	MDSR associated with line # 2	8977
...	...	...
2240	MDSR associated with line # 2241	8977
	Total (in bytes)	**20117457**

Table 4.3.2.8.3.a - Level 1b Full Resolution GeoCorrected Product - MDS(18)

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Corrected Latitude	(10-6)deg	sl	2241	8964
		Data Base size (in bytes)	**-**	**-**	**-**	**8977**

Table 4.3.2.8.3.b - Level 1b Full Resolution GeoCorrected Product - MDSR(17)

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5.4.8.5 - Measurement Data Set Records MDS(18) Altitude

A different MDS Record is associated to each frame.

The MER_FRG_1P MDS(18) has been summarised below:

MDSR no	Description	Size (bytes)
0	MDSR associated with line # 1	4495
1	MDSR associated with line # 2	4495
...	...	...
2240	MDSR associated with line # 2241	4495
	Total (in bytes)	**10073295**

Table 4.3.2.8.3.a - Level 1b Full Resolution GeoCorrected Product - MDS(18)

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

N	Byte #	Description	Unit	T	D	# bytes
1	0	*Start time of the Data Set Record*	mjd	sl	3	12
2	12	*Quality Indicator*	-	sc	1	1
3	13	Altitude	m	ss	2241	4482
		Data Base size (in bytes)	**-**	**-**	**-**	**4495**

Table 4.3.2.8.3.b - Level 1b Full Resolution GeoCorrected Product - MDSR(17)

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5.5 Status and Error Log Files

Status and Error messages can be issued by either the Amorgos shell script or the executable program itself. All messages follow a common format:

<date> <level> <source> <message> where :

- Date in these messages is formatted as <yyyymmdd hh:mm:ss.sss>, e.g. 20050722 18:30:37.000
- level indicates the nature of the message: INFO, WARN or ERROR
- source identifies the module/routine that issued the message: either amorgos.sh (possibly preceded by a UNIX path) when it is the message originator, or the source file name followed by the routine name and the source file line number where the message was issued when it comes from the executable program

Examples of shell script messages:

```
20050721 13:58:02.000 .ERROR /amorgos.sh: Cannot read configuration file
"test_amorgos.config"
20050721 14:10:27.000 INFO ./amorgos.sh: test_amorgos.config
20050721 14:10:27.000 INFO ./amorgos.sh: -NAME_OUTPUT_DIR="../OutputDir"
```

Examples of executable program messages:

```
20050721 10:10:09.000 INFO ../source/AmorgosApplication.c
AmorgosApplication_init_streams 148::frame count parameter missing : forced to
maximum (value) [2]
20050721 10:11:53.000 INFO ../source/AmorgosApplication.c
AmorgosApplication_reverse_sampling 349::sampling inversion progress bar
(percentage, processed frame count, total frame count) [10.0; 480;4801]
```

All these messages are normally logged into the Status log file and in addition into the Error log file if it is an error message (WARN and ERROR levels). However, in a few cases, it is impossible to create such log files and the messages are issued to the standard output. Such messages are clearly identified in the following subsections where all possible message texts are listed and described.

5.5.1 Informational messages

These messages are logged only in the Status Log File status.txt.
There level is: INFO
Possible messages are:

5.5.1.1.1 Shell script messages

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Message text	Description
Configuration File=”file_path”	reports the path to the configuration file
-NAME_OUTPUT_DIR=”path”	reports the path to the Output Directory
-NAME_INPUT_DIR=”path”	reports the path to the Input Directory
-NAME_DEM_DIR=”path”	reports the path to the DEM Directory
-NAME_AUX_DIR=”path”	reports the path to the Auxiliary Directory
path/amorgos –ipath –apath –dpath –opath [-t]	reports the full amorgos launch command (where path stands for the various directory paths requested)
path/amorgos finished correctly	The amorgos executable returned no error
path/amorgos returned error_number	The amorgos executable returned a non-zero error code specified as error_number

5.5.1.1.2 Executable program messages

Message text	Description
tiff output selected	indicates that the generation of the optional TIFF files has been enabled
sampling inversion progress bar (percent, current frame, last frame) [x, $n_{current}$, n_{last}]	monitors the processing progress status. x is the percentage of already processed frames, ncurrent is the index of the currently processed frame, nlast is the index of last frame to be processed. This message is issued every 10% of processing.
Output product processing limits (input product number of frames, first frame processed, last frame processed) [Nf_{in}, f1, f2]	Reports on the output product limits (with respect to the input product) and provides input product size for reference.

5.5.2 Error messages

These messages are logged in both the Status and Error Log files, status.txt and errors.txt.
Their level can be: WARN or ERROR
Possible messages are:

5.5.2.1 WARN messages

Message text	Description
no restituted attitude data available : use predicted	indicates that amorgos could not find restituted attitude data valid for the processing time window: either the AUX_FRA_AX file is missing (or not readable for any reason) or its content does not match the MER_FRS_1P time window. In this case, processing continues using predicted attitude model (as defined in the AUX_ATT_AX file provide in the AuxDir directory)
modified start frame (modified value) [f1]	Indicates that amorgos had to modify the user specified value of the first frame to process to comply withthe Granule Rule (see section 4.2.1) and provides the actual value f1.
modified frame count (modified value) [nf]	Indicates that amorgos had to modify the value of the number of frames to process to comply with the Granule Rule or with the maximum file size allowed (see section 4.2.1) and provides the actual value nf. Number of frames to process was either user specified through the configuration file or set to the input product value. It may require modifications in both cases.

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5.5.2.2 ERROR messages

5.5.2.2.1 Shell script messages

Messages that are sent to standard output:

Message text	Description
Cannot read configuration file [file_path]	The configuration file cannot be read. Consequently the Output directory is not defined and log files cannot be created. . Its path is specified within square brackets.
Output directory [path] doesn't exist	The output directory specified in the configuration file does not exist. Consequently the log files cannot be created. Its path is specified within square brackets.
Cannot write to output directory [path]	The output directory specified in the configuration file does not have the appropriate write permissions. Consequently the log files cannot be created. Its path is specified within square brackets.

Messages that are sent to the Log files

Message text	Description
Input directory [path] doesn't exist	The input directory specified in the configuration file does not exist. Its path is specified within square brackets.
Input directory [path] cannot be read	The input directory specified in the configuration file does not have the appropriate read permissions.
DEM directory [path] doesn't exist	The DEM directory specified in the configuration file does not exist. Its path is specified within square brackets.
Cannot read from DEM directory [path]	The DEM directory specified in the configuration file does not have the appropriate read permissions Its path is specified within square brackets.
Auxiliary directory [path] doesn't exist	The Auxiliary directory specified in the configuration file does not exist. Its path is specified within square brackets. Its path is specified within square brackets.
Cannot read from Auxiliary directory [path]	The Auxiliary directory specified in the configuration file does not have the appropriate read permissions. Its path is specified within square brackets.
Cannot execute amorgos (not in [path])	The amorgos executable software could not be found in the same directory than the amorgos shell script. Its path is specified within square brackets.
[path] missing	One of the input or auxiliary files is missing. Its path is specified within square brackets.
no orbit file available among path/DOR_VOR_AX path/DOR_POR_AX path/AUX_FRO_AX	None of the orbit file is available in the Input Directory (the path of which is repeated before the orbit file names)
At least one of the path/Pointing_at_Pixels_FR_SaCS.m? (? in [1,5]) is missing	One of the Pointing Vectors auxiliary files is missing in the Auxiliary Directory (the path of which is recalled before the file name).
At least one of the Product Description files is missing	One of the product description files is missing in the Auxiliary Directory .
At least one of the DEM files path/*.getasse30 is missing	One of the GETASSE30 DEM files is missing in the DEM Directory Auxiliary Directory (the path of which is recalled before the file name). The total number of such files shall be 288.

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5.5.2.2.2 Executable program messages

Message text	Description
file not found or not readable (path) [file_path]	One of the input or auxiliary files cannot be found or read. Its path is specified within square brackets.
no orbit file found	None of the three possible Orbit files is available or none matches the MER_FRS_1P time window.
no attitude file found	None of the AUX_FRA_AX or AUX_ATT_AX file is available.
invalid DEM directory (path) [DEMDir_path]	The path to the directory containing DEM files is invalid. The path is specified within square brackets.
invalid file format (path) [file_path]	The format of one of the input or auxiliary files is invalid. Its path is specified within square brackets.
could not create file (path) [file_path]	Amorgos was unable to create the MER_FSO output file. Its path is specified within square brackets.
could not create tiff outputs	Amorgos was unable to create the (one of) TIFF output files.
could not load pixels characteristics	An error occurred during the loading of the MERIS pixels pointing data (either from the MER_INS_AX file or from the pixel pointing vector files)
invalid time format (value) [UTC date time]	One of the start or stop times found in the MER_FRS_1P has a wrong format. The corresponding string is specified within square brackets. This is a strong indication that the MER_FRS_1P is corrupted.
read error during sampling reversion (line index)	The inversion of the Level 1b spatial re-sampling failed because of an out-of-range frame index in the input grid (Level 1b one). This is a strong indication of a wrong configuration.
write error during sampling reversion (line index)	The inversion of the Level 1b spatial re-sampling failed because of an out-of-range frame index in the output grid (Level 0 one). This is a strong indication of a wrong configuration.
position computation error (message) [error_message]	An error occurred during the Satellite Position computation. The message from the corresponding ESA provided software is reported within square brackets.
attitude computation error (message) [error_message]	An error occurred during the Satellite Attitude computation. The message from the corresponding ESA provided software is reported within square brackets.
tiff output error	The TIFF library reported a write error
cannot process imagette [path]	User tried to process an imagette MER_FR__1P product.
error during annotation copy	An error occurred during the copy of the Annotation Data Sets from MER_FRS_1P to MER_FRO_1P

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5.6 Optional TIFF output files

The MER_FSO_1P and MER_FSG_1P MDS data can optionally be output under the form of TIFF files (Tagged Image File Format), for graphic display or other purposes. The image geometry is the same than in the corresponding PDS product: either in Instrument projection for the FSO mode or in Level 1b grid for the FSG mode.
In this case, there is one TIFF file for each MDS with content and format as follows:

MDS	content	data type	unit	file name
MDS 1-15	radiance of bands 1-15	us	nc (same coding than MDS)	radiance.n.tiff, n in [1,15]
MDS 16	flags	uc	dl (same coding than MDS)	flags.tiff
MDS 17	longitude	sl	(10-6)deg (same coding than MDS)	longitude.tiff
MDS 18	geodetic latitude	sl	(10-6)deg (same coding than MDS)	latitude.tiff
MDS 19	geodetic altitude	fl	m (same coding than MDS)	altitude.tiff

Files are fully compliant to the TIFF format standard.

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6. Performances

Running the AMORGOS on a Linux (XEON 2.4 Ghz, RAM 1 Gb, SWAP 1Gb) we got the following performances:

Nb of L1b frames	Execution time (mn):
1025	2
2049	7
4033	10
4801	11

Run time performance for FSG and FSO modes are equivalent.

Note: execution time above were derived from system time at start and stop of execution and hence are only indicative as highly dependent on machine load. According to architecture, the number of frames in the input MER_FRS_1P product should be the main factor driving execution time.

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